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How can we increase our Cultivated Area ?

BY

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In my second note on the Possibilities of Increasing Agricultural Production in the State, I have pointed out that the Mysore agriculturist has at present apparently more land than he can efficiently cultivate. The average area under occupation during the five years 1915-1920 was 7,802,382 acres ; the average area under cultivation during the same period was 6,291,600 acres. There was in the possession of Mysore ryots an average area of 1,510,782 acres during these five years which did not bear any crop. If we add to this area, the area under Government assessed waste land, we get the respectable total of 2,303,092 acres which are supposed to be fit for cultivation but which annually bear no crops. But this is not all. The Government date reserves and *amrut mahal kavals* have already furnished or are likely soon to furnish us with another 600,000 acres available for cultivation while the *Gomal* lands of the State which probably amount to 3,000,000 acres would undoubtedly furnish another million acres of cultivable lands which could be made to yield immensely more productively either as a source of food for cattle or as a source of general agricultural produce than they now are doing.

While undoubtedly some of this land which is now lying fallow and which is giving practically no return lies near the margin of cultivation, the size of this area has undoubtedly greatly contracted during the past few years. Land which it was unprofitable to cultivate when ragi was selling at 18 to 20 seers to the rupee might be cultivated with considerable profit when ragi is selling at 8 to 10 seers to the rupee. One is, in fact, forced to conclude that much of our land is lying waste to-day not because it would be unprofitable to cultivate it, but because our agricultural population is not able to cultivate it with the means at their disposal.

A certain amount of this land which is at present lying unproductive is in the hands of large land-owners who on the one hand cannot procure suitable tenants for the land and on the other hand have not been able to procure and organize labour for the cultivation of the land themselves. From these have come during the past few years fairly frequent applications for advice as to the possibility of introducing tractor cultivation. Many of our large land-holders feel that they will never be able to bring their extensive holdings under cultivation unless and until they can call to their aid the tractor and tractor tillage implements.

What stands in the way of introducing these western machines and methods and why is the Agricultural Department pursuing what must seem to many as an ultra-conservative policy with regard to them ? In the first place it must be pointed out that the amount of our uncultivated land already under occupancy which is in holdings large enough to be suitable for tractor cultivation forms a very small proportion of the total. The assessed waste land which still remains in Government possession is also for the most part in scattered blocks and much of it is too stony and rocky in character to allow for mechanical cultivation.

It seems to me therefore that under present conditions it would be distinctly unwise, in fact it would be unwarranted for the State Agricultural Department to spend large sums of money in experimenting with tractors and tractor tillage implements when the results of such work would be useful for a very small percentage of our agricultural population and could be applied to a very small proportion of our total cultivable area.

It must be made perfectly clear that such experimental work is necessary before any recommendation can be made. A number of different types of tractors and tractor implements have already been tested in the State and many more have been tried in other parts of India but I have yet to see definite evidence that any one of these is adapted to the general conditions prevailing at least in South India and can be confidently recommended to our land-holders as a safe investment.

Let us see what the facts are. The initial cost of a tractor and the implements which are necessary to accompany it is fairly high. From five thousand to six thousand rupees would be about the minimum required for a light tractor and its implements while heavy tractors cost much more. The depreciation on tractors is very heavy. Even in America where the general skill of farm labour is very much higher than in India the rate of depreciation is usually placed at 20 per cent. The annual repair bill is likely to be fairly heavy and what is much worse, where parts break and have to be replaced it usually takes several weeks to procure the spare parts. A number of cases have come to my attention where tractors have been kept idle for months owing to the difficulty of obtaining these replacements.

This is the greatest difficulty standing in the way of tractor use in South India. Ploughing operations must be timed to catch the rains and a delay of several weeks would be practically fatal to cultivation. An agriculturist would therefore have to keep two tractors to insure that his work should not be held up by break downs or would have to keep bullocks and bullock implements in fairly large numbers as a stand-by. If he had not a sufficient labour supply even this would not avail him. Finally the actual cost of ploughing with a tractor is at least twice as great as ploughing with bullocks.

A medium tractor can be safely taken to do as much ploughing and cultivating work as six pairs of bullocks and the saving in manual and bullock labour is therefore great. If the large scale agriculturist could be sure that his tractor would not break down or if it did that he would be able to get spare parts within a day or so, this saving in labour might make it worth his while to undergo the extra expense for his tillage operations. Until he has this assurance, I believe, the purchase of a tractor with the intention of depending upon it would be a risky business.

If we cannot in the immediate future expect the tractor to solve the difficulties in the way of bringing the maximum arable land into cultivation and keeping it cultivated, where are we to look for help ? It is, I believe, firstly in the rapid introduction of improved bullock drawn implements and secondly in the improvement of our draft cattle so as to make them capable of pulling really efficient improved implements. The opinion which is still at times expressed but which has lost ground rapidly during the past few years that a very large proportion of our draught cattle are incapable of pulling efficient improved implements is quite wrong. A very large proportion of the draught cattle more especially in our *maidan* districts are capable of working these implements satisfactorily. However, even in the *maidan* districts there is immense scope for improvement, while in the *malnad* districts the poor quality of the cattle is undoubtedly a serious obstacle in the way of introducing improved implements. The small Meston plough and the somewhat larger Eureka plough which are at present being sold in considerable numbers in those districts are undoubtedly a big improvement on the country plough but they are far from being an ideal implement and should be replaced with something better as soon as an improvement in draught bullocks will admit.

The average size of a holding in Mysore is between six and seven acres. That the agriculturists in Mysore cannot bring this small area under crop each year indicates lamentable lack of efficiency. This lack of efficiency is to a very great extent due to inefficient tillage implements and more especially inefficient ploughs. The average holding in Canada is approximately one hundred acres and it is safe to say that a smaller number of labourers are required to cultivate the one hundred acres in Canada than the six or seven acres in Mysore. The peculiar agricultural conditions existing here and the nature of the crops grown would not allow of such a large area being cultivated per man as in Canada — no matter how efficient the implements, but who can doubt that a very great increase of efficiency could be achieved ? With the areas of uncultivated land yet at our disposal, it should be possible to increase the area cultivated each year by fifty per cent and the most efficient means to achieve that end is by the introduction of improved agricultural implements and the improvement of our draught cattle to draw them.

The Spraying Work against Areca Koleroga.

BY

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Readers of this journal will be interested to know something of the large amount of work done by the Department in combating the areca koleroga in the malnad, in the face of the many difficulties attending it. In the present article, I shall draw attention to some of the chief difficulties which are being experienced in conducting successfully this large amount of work. In carrying out any such campaign to a successful issue, it is quite important to take cognizance of all the obstacles in the way so that steps may be taken as far as possible to minimise them. I shall first mention some of the general difficulties met with. The short amount of time at our disposal for the spraying of very large areas is a point to be taken into consideration. The work that has to be done extends over five taluks of the malnad, *viz.*, Koppa, Thirthahalli, Sagar, Nagar and Sorab, and that within two or three months, for by the middle of July, the monsoon will have set in vigorously. The men and materials required for the spraying work will have to be got ready long before the outbreak of the monsoon, since later on, transport of materials cannot be thought of, owing to the condition of the roads, which are often blocked up by unfordable rivers. To add to this, the difficulty of getting carts is keenly felt during the rains, which in some places go up to 390 inches, as in the Agumbe region.

A very important point which has to be taken into consideration before putting on the spray, is the proper size of the nuts which must be at least half ripe. During the month of June, one can see that the size of the nuts varies in different gardens. In some of the gardens the nuts will be of a size for spraying even by the end of May, and in some, it is later by the first week of July, while generally they can be sprayed by the middle of June. Even in the same garden some of the trees will be ready for harvest by the middle of August, and some of the trees will have nuts yet tender. It is important to study the early or late maturity of the crop in each garden before spraying it against the disease.

The stage has passed when the difficulty of convincing the people

of the efficacy of the spray, is to be seriously considered. There were such beliefs—occasionally lingering even now in some—as that the spray dropping on the plantain leaves below, poisoned the food, or killed the betel and pepper vines, or burnt the stem of the arecanut turning it black. This last belief was due to the fact that the spray killed the green outgrowths on the stem, such as mosses, and turned them black. The popularity of the work has reached some of the inmost regions of the malnad, and such common place objections against the work are very rarely met with.

We have not felt much difficulty in getting together the materials required for spraying though these have to be transported in time from various parts of India. The chief difficulty has been in regard to getting sprayers. As well known to the garden owner, the sprayers that were in use before the war were all imported from Germany. During the war, attempts were made to manufacture them locally, but with very poor results, since these sprayers were neither efficient nor cheap. The sprayers imported from England last year were fairly satisfactory, but still left much to be desired. It is likely that we may get a consignment of the German sprayers this year. The difficulty of getting good sprayers stands much in the way of the proper conducting of the spraying work.

The chief aim of the Department is to educate the garden owner himself in the work. The temporary staff employed in conducting the work is composed solely of local men, so that most of the garden owners know how to prepare the spraying mixture or to repair a sprayer. With the expansion of the work in different areas a greater number of men get in touch with the work so that at present there is quite a large body of men who know the details of the work.

A very important point which has to be borne in mind while combating this disease is the great rapidity of the spread of infection from tree to tree. Favoured by alternate sunshine and rain, the disease first appears in a few trees generally in particular parts of the garden, and in a week the whole garden shows signs of the vigorous spread of the disease. As pointed out by Dr. Coleman in the Koleroga Bulletin, the infection is carried from tree to tree along with the fine spray caused by the lashing wind and rain. It will not be out of place to point in this connection the great facility afforded

by the owners themselves for the spread of infection from garden to garden. I refer to the practice of collecting the diseased nuts and throwing them out on the road side or often on elevated places outside the garden with the pious hope of propitiating the deity. Though not actually proved it is quite likely that the infection may spread on to the garden in the next valley, owing to this practice. The chances of infection will be greatly lessened if this offering to the deity is made through fire.

The rapidity of the infection naturally necessitates the taking of very active steps in the way of spraying. Experience goes to show that, even in gardens where the infection has got ahead, spraying has a good deal of effect in bringing the disease under some control.

As is well known the large block gardens form a characteristic feature of the malnad, many of these extending over a continuous stretch of 20 to 40 acres. Each of these large blocks is invariably owned by quite a number of people. For instance, the large block at Sampekatte, in Nagar Taluk, extending over an area of 75 acres is owned or leased by 34 people. In such cases if only some of the persons spray a few trees here and there, and the rest adopt the local remedy of tying *kottes* over the bunches, there is always the danger not only of the sprayed areas getting affected by the constant proximity of the disease in the unsprayed areas, but of the yearly perpetuation of the ravages of the disease in all its unmitigated virulence. That the virulence of the disease is considerably lessened by spraying for a few years is shown by the experience of the garden owners. In the Agumbe garden, where the disease was at its worst a few years ago, the disease has been completely stamped out after five years of spraying. It is now eight years since any spraying was done in the garden and the disease has not made its appearance even on a single tree.

In order to realize the beneficial effects of the spraying to the fullest extent the entire block of garden should be sprayed. With this object in view, it is highly desirable that garden owners of one block should co-operate in their work. Where, in a block garden, there are more people who spray the garden, than those who do not, the former should persuade the latter to take up the work in the interests of both. If such an amicable arrangement cannot be arrived

at, the Department possesses the right to insist that the entire garden must be sprayed, as authorized in the Pest Act passed by Government. So far it has not been found necessary to put into practice, in any of the gardens, the stringent measures provided by the Pest Act regulations.

A very great difficulty in the conducting of the spraying work is the dearth of climbers during the season. Great stress has been laid on this fact by some, while urging the impracticability of this work. Most of the climbers—if not all—are men from down the ghauts, who are available for work in the garden from July and August, later in the monsoon than earlier which is the season for spraying. It has also been urged that spraying involves hard and skilful work which many climbers, trained in kotte-tying, are not ready to undertake. I do not intend entering into the details of the labour problem in the malnad for which if any workable solution were found, the malnad ryot will be quite thankful. I wish to bring forward a few facts to show that the problem has been solving itself at least in connection with the koleroga work.

The amount of work done during the last four years is as follows :

Work during		Application received for	
1919.	1920.	1921.	1922.
170 acres	410 acres 32 guntas	750 acres	1900 acres

As can be seen there has been a rapid increase in the work, which means of course more climbers for work. With the rising popularity and faith in the spraying work, the garden owner himself has been trying to make proper arrangements beforehand for the supply of climbers in time instead of hunting for them after the breaking out of the disease in the garden. Moreover there are a number of local men in the malnad, not to speak of the garden owners themselves, who are made available for spraying work. The writer believes that a little more exertion on the part of the owner in arranging for the climbers, coupled with a little more consideration for the climbers in the way of payment than is at present the case will go a long way to solving this problem of the alleged dearth of climbers. During the present year many of the garden owners have responded to the advice of the Department, and have made satisfactory arrangements for the supply of climbers.

I shall here mention another instance of the people themselves taking an interest in the work. In the Nagar Taluk, the work of the Department previous to 1919, had been only of the nature of demonstrations, here and there.

work during 1919	work during 1920	work during 1921	application received 1922
about 7 acres	16 ac. 10 g.	156 ac. 28 g.	about 320 acres

The work in the area near Kodachadri has been entirely due to the enthusiasm of the garden owners. This year the entire area of 75 acres at Sampekatte will be taken up and sprayed by the climbers supplied by the owners themselves.

An attempt is, however, being made in the direction of inducing some influential persons to take up the work of forming a sort of agency for climbers, and lending them for work, in various gardens round about. As a matter of fact, the Department has always been trying to induce individual garden owners to spare their climbers for work outside, as soon as their own work is finished. It is not known with what success this attempt at forming an agency will be attended.

Attempts are also being made in the way of facilitating the purchase of materials by the garden owners. Though depots are opened at the Taluk headquarters they are not within easy reach of many of the gardens in the interior, on account of the difficulties of transport. To meet this difficulty a number of branch depots have been opened in important villages. With all this, still we find that some of the small landholders are not able to purchase the chemicals, as they have not the money for purchasing during the season. Owing to the proverbial indebtedness of the malnad ryot, the amount realized by the harvest during December, will be collected by the money-lender, so that it is with great difficulty that a sum can be invested in June on the spraying work. Since the Department cannot go on selling materials on credit, attempts have been made to place a large stock with some of the influential garden owners, who will take the responsibility of selling on credit, with the object of forming something like a co-operative society. The formation of a number of such societies in the interior of the malnad will greatly facilitate the increase of work.

I need only make a passing mention of the lease system which

as is well known stands in the way of agricultural improvements owing to the lack of interest of the absentee landlord. But fortunately many of the men who have taken up the garden on lease, have realized the importance of the spraying work. It is not seldom that the landlord himself takes an interest in his tenant and helps him in the purchase of sprayers and chemicals.

In conclusion, I wish to urge on those concerned the necessity and desirability of taking up the spraying work independent of any Departmental help, and considering it as one of the items of their own agricultural operation.

Availability of Phosphates in Red Soils.

(A Preliminary Report.)

BY

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To get some data as to the availability of Phosphates, specially the soluble ones like Superphosphates, in red soils fairly rich in iron and aluminium, a series of experiments was started in July 1921. In addition to finding out the availability of the soil phosphate itself under various conditions, 2 chemically pure phosphates and 3 phosphatic manures were selected for study under similar conditions. The plan of the experiments was briefly as follows :—

1. Check series, *i.e.*, soil by itself without any addition of phosphate.
2. Series manured with monocalcic phosphate.
3. Do tricalcic phosphate.
4. Do superphosphate.
5. Do basic slag.
6. Do bone-meal.

Each of these series had four groups for the study of the availability under different conditions as follows :—

(*a*) Nitrogen given in the form of $AmNO_3$ to ensure a good supply of nitrogen and bring the phosphate into utilisation.

(*b*) $AmNO_3$ and a small quantity of powdered dung to study the influence of organic matter on the phosphate.

(*c*) $AmNO_3$ and K_2SO_4 to study the influence of potash.

(*d*) Am_2SO_4 as a source of nitrogen instead of $AmNO_3$ to study the effect of a physiologically acid salt on the availability of phosphates, specially the insoluble ones.

All the precautions usual in pot-experiments have been taken and each treatment quadruplicated in order to eliminate the experimental error as far as possible. The soluble manures were all mixed with the soil as solutions and the insoluble ones as powder, when filling the pots. Nitrogen in one of the two forms mentioned above was given at the rate of 2 gms. per pot and potash at the rate of 3 gms. per pot as sulphate. Phosphoric acid in one of its various forms used, was given at the rate of 7.5 gms. per pot. The moisture content of the soil was maintained at 70 per cent of its water-holding capacity throughout the period of growth of the crop. All the pots were sown with H22 ragi on the 28th July 1921. After the plants had got well established the number of plants in each pot was reduced to 12. The harvesting took place between 14th November 1921 and 18th November 1921. The plants in the pots manured with superphosphate showed a vigorous start from the very beginning, but no appreciable difference in the time of ripening of grain could be detected.

The average yields of grain and straw from 4 similarly treated pots and also the amount of P_2O_5 recovered in the crop are given in the table on page 127. Subtracting the figures of the check series in each group from figures obtained for the series of various phosphates in each corresponding group, we get the following increased yields in grain and straw from the use of various phosphates:—

Phosphate and	Increased yield of grain from the use of			
	Ammonium nitrate gms.	Dung gms.	Sulphate of potash gms.	Ammonium sulphate gms.
Monocalcic phosphate	8.7	4.2	6.6	12.7
Tricalcic phosphate	4.9	6.4	5.6	8.3
Superphosphate	20.9	11.0	5.4	16.8
Basic slag	10.9	2.4	—3.1	—2.2
Bone-meal	12.6	5.9	2.9	8.0

Phosphate and	Increased yield of straw from the use of Ammonium nitrate gms.	Dung gms.	Sulphate of potash gms.	Ammonium sulphate gms.
Monocalcic phosphate	14.1	3.3	18.1	22.6
Tricalcic phosphate	10.6	9.4	20.9	21.0
Superphosphate	32.7	26.5	18.6	35.0
Basic slag	12.7	0.9	7.5	—4.2
Bone-meal	25.5	4.7	7.3	13.4

These figures bring out the fact that superphosphate has acted most beneficially on the whole. Bone-meal, basic slag and monocalcic phosphate are not far behind each other in the production of grain in the $AmNO_3$ group, though bone-meal has produced more straw than the other two. In the second or dung group, all the other phosphates are distinctly behind superphosphate in their action. In the third or potash group, there is not much to choose between monocalcic, tricalcic and superphosphate. In the last or ammonium sulphate group, monocalcic phosphate is slightly behind superphosphate whereas tricalcic phosphate and bone-meal do not show any difference between each other. The negative yields in the case of basic slag in the potash and ammonium sulphate groups are too small for any importance to be attached to them.

Coming now to the total air-dry matter produced by the various phosphates in the different groups, the following table gives the increased yield over the check series in each group:—

Phosphate and	Increased yield of total dry matter from the use of Ammonium nitrate gms.	Dung gms.	Sulphate of potash gms.	Ammonium sulphate gms.
Monocalcic phosphate ..	22.8	7.5	24.7	35.3
Tricalcic phosphate	15.5	15.8	26.6	29.3
Superphosphate	53.9	37.5	24.0	51.8
Basic slag	23.7	3.3	4.4	—6.4
Bone-meal	38.0	20.6	10.2	21.4

These figures also show the superiority of superphosphate on the whole. Bone-meal comes next to it in the groups in which ammonium nitrate has been used without and with dung. Basic slag and monocalcic phosphate are equal to each other in the ammonium nitrate group. In the potash group there is not much difference between tricalcic phosphate on the one hand and monocalcic and

superphosphate on the other. In fact, tricalcic phosphate seems to be even a trifle better than the other two. In the ammonium sulphate group, monocalcic phosphate, tricalcic phosphate and bone-meal come in order after superphosphate. Except in the ammonium nitrate group, basic slag has shown the least effect.

With regard to the recovery of phosphoric acid from the phosphates under different conditions, the following table gives the necessary information :—

Phosphate and	Increased assimilation of phosphoric acid from the use of			
	Ammonium nitrate mgs.	Dung mgs.	Sulphate of potash mgs.	Ammonium sulphate mgs.
Monocalcic phosphate ..	768	504	798	962
Tricalcic phosphate	230	330	372	638
Superphosphate	775	632	716	913
Basic slag	236	141	219	57
Bone-meal	193	71	116	78

The above figures show that the two soluble phosphates, monocalcic and superphosphate, have acted best on the whole. Of the insoluble phosphates, tricalcic phosphate stands first and bone-meal last. The increased recovery of phosphoric acid from some of the phosphates used is not proportional to the increase in yield of crop, but, as will be seen from the table given below, is mostly due to the richness of straw in phosphoric acid :—

Treatment	P_2O_5 in grain %	P_2O_5 in straw %
No phosphate	0.70	0.25
Monocalcic phosphate	0.74	0.90
Tricalcic phosphate	0.71	0.56
Superphosphate	0.72	0.76
Basic slag	0.73	0.39
Bone-meal	0.68	0.28

The figures obtained with regard to yield and recovery of phosphoric acid can be manipulated in a different way and information gained as to the influence of dung, potash and ammonium sulphate on the crop and the availability of one and the same phosphate. The following table gives the increased yields over those of the ammonium

nitrate series for the soil phosphate itself as well as the various phosphates used:—

Description	Dung gms.	K_2SO_4 gms.	Am_2SO_4 gms.
Increased yield of dry matter owing to the use of			
Only soil	18.9	35.0	15.4
Soil and monocalcic phosphate ..	3.6	36.9	28.6
Soil and tricalcic phosphate ..	19.2	46.0	30.0
Soil and superphosphate	2.8	5.4	14.3
Soil and basic slag	..	15.7	—14.0
Soil and bone-meal	1.4	7.1	— 0.6
Increased recovery of phosphoric acid in mgs.			
Only soil	183	109	72
Monocalcic phosphate	—81	139	266
Tricalcic phosphate	263	250	479
Superphosphate	40	89	61
Basic slag	89	92	—106
Bone-meal	61	31	—43

The above figures show that potash has had the most effect in producing increased yields from the soil itself as well as from the use of various phosphates except superphosphate. That Am_2SO_4 has depressed the yield in the case of basic slag is not at all surprising, for, it ought not to be mixed in practice with such a manure as basic slag at all. The beneficial effect of potash salts on the availability of basic slag has already been well established in Germany by the researches of Haselhoff and others, and seems to be confirmed here as well. The use of dung has shown some effect only on the soil and tricalcic phosphate.

Coming now to the assimilation of phosphoric acid, the use of dung has had a beneficial effect on the soil phosphate as well as tricalcic phosphate, but the phosphoric acid assimilated is not commensurate with the increased yield obtained. Its effect on superphosphate, basic slag and bone-meal is negligible. The slight depression in the case of monocalcic phosphate needs further study and confirmation. The effects of potash on the availability of various phosphates look quite consistent with the crop yields from them. The effect of ammonium sulphate too on the crop as well as the assimilation of phosphoric acid from the

phosphates seem to be quite in agreement with each other. It is only in the case of bone-meal that the results are rather contrary to expectations and experience in other countries. But the results require confirmation before anything definite can be said at all.

Till now nothing has been said as to the nature of the soil used for these experiments. It is no doubt red soil from typical ragi fields found in the State. But its previous history with regard to manuring is rather interesting. Since 1907, for about 10 years or so, it had been manured annually with basic slag at 3 cwts. per acre, sulphate of potash at 80lbs. per acre and lime at 7.5 cwts. per acre, and cropped with ragi. Such a soil may not very well be expected to respond to phosphatic and potash manures. It has in fact done so even to basic slag itself, and in an increasing degree to superphosphate. The response is likely to be greater when the phosphates are applied to soils not previously manured so at all. In fact, the experiments are being repeated this year with a soil not manured with phosphates since 1907.

		Weight of crop in gms.			P_2O_5 in crop mgs.		
Pot Nos.	Treatment	Grain	Straw	Total	Grain	Straw	Total
	(a) Nitrogen as ammonium nitrate.—						
1—4	No phosphate	26.5	77.5	104.0	185.5	186.0	371.5
5—8	Monocal. phos. ..	35.2	91.6	126.8	260.5	879.4	1139.9
9—12	Trical. phos.	31.4	88.1	119.5	222.9	378.8	601.7
13—16	Superphos.	47.7	110.2	157.9	342.4	804.5	1146.9
17—20	Basic slag	37.5	90.2	127.7	273.7	333.7	607.4
21—24	Bone-meal	39.0	103.0	142.0	265.9	298.7	564.6
	(b) Ammonium nitrate and powdered cattle dung.—						
25—28	No phosphate	40.4	82.5	122.9	282.8	272.3	555.1
29—32	Monocal. phos. ..	44.6	85.8	130.4	330.0	729.3	1059.3
33—36	Trical. phos.	46.8	91.9	138.7	332.3	533.0	865.3
37—40	Superphos.	51.4	109.0	160.4	370.0	817.5	1187.5
41—44	Basic slag	42.8	83.4	126.2	312.4	383.6	696.0
45—48	Bone-meal	46.3	97.2	143.5	314.8	311.0	625.8
	(c) Ammonium nitrate and sulphate of potash.—						
49—52	No phosphate	44.3	94.7	139.0	310.1	170.4	480.5
53—56	Monocal. phos. ..	50.9	112.8	163.7	376.7	902.4	1279.1
57—60	Trical. phos.	50.0	115.6	165.6	355.0	497.0	852.0
61—64	Superphos.	49.7	113.3	163.0	357.8	838.4	1196.2
65—68	Basic slag	41.2	102.2	143.4	300.8	398.6	699.4
69—72	Bone-meal	47.2	102.0	149.2	321.0	275.4	596.4
	(d) Nitrogen as ammonium sulphate.—						
73—76	No phosphate	35.7	84.4	120.1	250.0	194.1	444.1
77—80	Monocal. phos. ..	48.4	107.0	155.4	358.2	1048.6	1406.8
81—84	Trical. phos.	44.0	105.4	149.4	312.4	769.4	1081.8
85—88	Superphos.	52.5	119.4	171.9	378.0	979.0	1357.0
89—92	Basic slag	33.5	80.2	113.7	244.6	256.6	501.2
93—96	Bone-meal	43.7	97.8	141.5	297.2	224.9	522.1

A Visit to the Imperial Silk-worm Rearing Rooms in Tokyo.

BY

H. S. Govinda Rao, B. A.,

Sericultural Inspector on deputation.

Through the kindness of Dr. I. Honda and the authorities of the Imperial Household, I had the rare privilege of visiting the silk-worm rearing rooms in the precincts of the Palace of Her Majesty the Empress of Japan on 26th May 1922. I entered the Palace grounds with Dr. Honda and we were met and taken round by Prince Saujo, a Secretary to Her Majesty.

It is well known that the present flourishing condition of the sericultural industry of Japan owes a great deal to the encouragement given and personal interest shown by the members of the Imperial House from the earliest days. At the close of the Russo-Japanese war in 1905, when the Japanese Empire was suffering from a deflated currency, the need for increasing exports was felt and the production of raw silk, which has always been a commodity in world-wide demand, naturally received careful attention. To give an impetus to the industry and to emphasize its national importance, Her Majesty the late Empress started rearing silk-worms in the Aoyoma Palace in Tokyo. A portion of the Palace was fitted up to serve as a rearing room, mulberry was planted in the Palace grounds, and rearing, reeling and even weaving were done in the Palace precincts under Her Majesty's own supervision. She also visited rearers' houses in the provinces as well as the experimental station at Nishigahara. This manifestation of Imperial interest braced up the Government and the people to vigorous effort, and production was pushed up throughout the country. The export of raw silk, which had averaged to about 10,000,000 lbs. per year during 1901–10, rose up to 30,500,000 lbs. per year in 1911—1920.

The present Empress's enthusiasm for the industry dates back to the time when as Crown Princess she started rearing silk-worms in the Imperial Palace. After becoming Empress in 1912 she had the present rearing rooms constructed near her own Palace and started rearing silk-worms in the new building in 1914.

The rearing house is situated on a small hillock, the highest place inside the Palace grounds, called Momiji-Yama or maple mount.

It is situated near the Imperial Photographic studio and is about 10 minutes' walk from Her Majesty's apartments, in the midst of a well-laid-out garden bounded by tall trees. It overlooks the living rooms of Her Majesty's Ladies of Honour on one side and an old deep moat called Dokan-bori on the other. It consists of three sets of buildings connected together.

As one enters the grounds, to the right is situated a building divided into three rooms. The first room to the right is the waiting room for the Ladies of Honour attending on Her Majesty. The centre room is the resting room of Her Majesty when she visits the rearing rooms. This room is plainly furnished and has a table and a chair made of mulberry wood. The table is covered with a richly embroidered silk cloth, woven from raw silk prepared in the Imperial rearing rooms. The borders of the table-cloth are exquisitely embroidered with a design of which the foundation is cocoon and mulberry leaf, and the centre has the figure of two silk-worm moths. In this room the place of honour is given to the picture of the patron goddess of silk-worms. Just before the rearing season commences, the brushing ceremony is held in this room. On the day appointed, the Empress after making offerings to the goddess, brushes and feeds a small quantity of worms with her own august hands in the presence of a select party including the Director of the College at Nishigahara.

Leaving this room, we enter through a covered pathway, into the main rearing house which forms the central portion of the group of buildings. It is simply constructed and differs from the ordinary rearing houses only in being perfectly clean and tidy. The trays and all the appliances are just the same as are used by the ordinary rearers. There are four rearing rooms, with a hall in the centre used as a small museum, and a room for chopping mulberry leaves, and an underground room for preserving mulberry. The upper storey of the rearing rooms is used as the mounting room and in case of necessity, for rearing also. Each of the rearing rooms is provided with two stands against the walls and a fireplace in the centre. Each stand is capable of holding 66 trays. As usual the rearing rooms are bounded by a corridor about 4 feet broad. The rearing house is in charge of Mr. Ari-izumi, a graduate of the Sericultural College at Nishigahara.

Rearings are conducted in the spring season only. This year, worms from about 7 ounces of eggs were brushed on 5th, 6th and 7th May. The majority of eggs brushed was of the Japanese univoltine race Koishimaru, though cross breeds and pure Chinese and European races were also reared. At the time of my visit the worms were in 4th and 5th stages. All the methods of rearing practised in Japan, *viz.*, chopped leaf-feeding, cut-shoot feeding and branch-feeding were being practised here also. This year a specially constructed small stand for rearing with branches was being experimented with, with the idea of being installed in Her Majesty's rooms next year if found successful.

Her Majesty visits the rearing rooms almost every alternate day and spends not less than a couple of hours in going round and examining the worms, etc. She is very anxious that rearings should be successful and feels much concern if any diseased worms should be found. As rearing is mainly the work of women, she wishes to set an example to her subjects. In addition to the big rearing, she keeps about 2,000 worms in her own rooms and attends to the feeding, etc., herself. I was told that these worms though brushed on the same day as the rest were about 10 hours in advance of the rest of the worms in the big rearing house.

All the cocoons produced in the Imperial Rearing Rooms are sent to the Sericultural College at Nishigahara for stifling. A part of the stifled cocoons is reeled in the Palace grounds while the greater portion is reeled in the Sericultural College at Nishigahara and the raw silk sent to the Palace. The raw silk produced is woven into cloth either in the Palace grounds or in the Higher Technical School at Kyoto. The yield of cocoons this year is said to be 900 lbs.

As regards mulberry, there is a garden of about $1\frac{1}{2}$ acres in the Aoyama Palace. In the main Palace there is a plantation of altogether 3 acres of which about $1\frac{1}{2}$ acres have been planted this year. The mulberry is mainly in the form of bushes.

After leaving the rearing house we came to another building contiguous with it. This building is used as the residential quarters of workers in the rearing house. These people are fed and housed free of charge when the rearing is in progress.

Before concluding, I would like to mention an incident which

indicates how deeply the Empress is interested in the industry. Mr. Ari-izumi told me that, when Her Majesty visited the rearing rooms on the 25th May, *i.e.*, the day previous to my visit, she was told that an Indian would be visiting the rearing house next day. It appears she evinced great interest and instructed Mr. Ari-izumi to explain things very carefully and in detail to the Indian gentleman. It was very gracious of Her Majesty to have taken so much interest as to give special instructions. I offered my most respectful thanks through Mr. Ari-izumi for this kind and gracious interest of Her Majesty.

At the close of our visit at about 12 noon, we were given the usual green tea and special cakes.

I cannot close this report without mentioning my deep sense of gratitude to Dr. I. Honda for having arranged for my visit to the Imperial rearing rooms, this being the first instance of an Indian having had such a privilege.

Notes on the more important Insect Pests of Crops in the Mysore State.

BY

T. V. Subramania Iyer,

Assistant Entomologist, Mysore Agricultural Department.

(Continued from our last issue.)

V. ORTHOPTERA.

Grasshopper pests.—The common grasshoppers are known to the Mysore ryots as "*Miduthe*" in Canarese, and he is quite familiar with them on account of their suddenly jumping off when disturbed. Very many are not found as serious pests of crops, but two were known as serious pests of jola (*sorghum*) and paddy in the State some years back, these being the Deccan Grasshopper on the cereals and the Rice Grasshopper on paddy.

(1) The Deccan Grasshopper.

Colemania sphenarioides, **Bol.**

Mys. Ent. Bull. No. 2.

This is a wingless Grasshopper known to exist in the Mysore State since 1906-1907, but it became a very serious pest in the yeare

1910-11, when very extensive areas of jola were damaged from July to November. The pest was more pronounced in the black cotton areas than on the red soils. Chitaldrug, Harihar and Honnali were the places where it was bad.

Excepting a few stray ones here and there in the season the pest has not appeared in numbers in the State since 1912.

(2) The Rice Grasshopper.

Hieroglyphus banian, **Fb.**
Mys. Ent. Bull. No. 1.

This pest of paddy is found from June to November in Anavathi and Shiralakoppa in the Shimoga Dt. This has ceased to be a pest since 1913. For full details about this and the Deccan Grasshopper, see Mys. Ent. Bulletin Nos. 1 & 2.

(3) Surface Grasshoppers.

These Grasshoppers belonging to different genera and species, often appear in fairly large numbers soon after the South-West monsoon rains begin in May or June. These are occasional serious pests of all dry land areas of the State, damaging cotton, jola (*sorghum*), gingelly, etc. The damage is done only when the crop is very young so that it is completely lost and resowing of the area becomes necessary. They are not found year after year in the same locality and their occurrence as a pest depends upon the condition of the growth of the weeds and grass on the surrounding fields. When rank vegetation is plenty around sown areas, no trouble from the grasshoppers has been noticed. In some areas the surrounding vegetation is very scarce and the cultivated area shows up green fresh vegetation of the very young seedlings; a number of grasshoppers rush to these fields and do a great deal of destruction to the crop.

Control.—(i) Bagging was found very effective in a jola field one year in Santebennur (Shimoga Dt.).

(ii) Poisoned bait of molasses, bran, arsenic, etc., was tried without any success.

(4) *Aularches miliaris*, Dinn.

This insect is confined to the coffee estates, especially to those at lower altitudes. It is found in colonies here and there in an estate doing a certain amount of damage by eating coffee leaves, but not

found as a serious pest. It is generally found breeding in September-October.

Control.—It is a very sluggish insect and is easily caught and destroyed. Small boys are told off for this purpose in some estates.

(5) *Brachytrypes portentosus*, **Licht.**

S. S. I. I., p. 536.

This stout-built light-brown insect was found to cut off the tender shoots of orange trees and thus damage the trees to a certain extent. The insects hide during the day under the shelter of dry leaves, etc., in the plant and suddenly jump off when disturbed and do the work of destruction during nights.

VI. NEUROPTERA.

White Ants.

The insects under this order are familiar to all. Their attack upon our furniture, books, wood work of houses, etc., is a very common occurrence. White ant attack has been found serious on sugarcane setts planted on a newly opened out land and on grape vines among fruit trees in different parts of the State.

White ants on sugarcane setts.—A large area planted with sugarcane was very seriously damaged by white ants in Kankanhalli, Bangalore Dt. The land was a newly opened one, the soft internal tissues of the setts were found to be eaten up completely and the space packed with earth, whereas the rind was found to be left intact. The attack was noticed in April.

Different repellant substances were tried in experimental plots, *viz.*, dipping the setts in copper sulphate, application of phenyle in irrigation water, a coating of lead arsenate and the application of castor cake in the rows in which the setts are planted. The attack on the setts was only a question of time. The rows where castor cake was applied was the last to be attacked.

White ants on grape vine.—The attack was very persistent and serious in a vineyard newly planted in Bangalore some years ago. Rooted vines were planted 10 feet apart each way in about 20 acres and the loss was serious owing to white ant attack on the portions of the vines just below the ground level. The main stem flush with the ground was found ringed in many cases and several plants died, every morning a number of coolies had to be told off for white ant removal from the grape vine stems. The soil around almost every plant had

to be dug out up to the roots and a mixture of phenyle and water poured on the stem and hollow around, a paint of shellac dissolved in alcohol was given and the earth put back again. Several other so called white ant protectors like "gondal fluid", "aloes", etc., were tried without success.

Digging out the white ant hills in and around the vineyard and the destruction of the "queen ants" in these were the methods adopted. The attack on the plants was found very much lessened after a number of mounds and the queen ants were destroyed.

Occasionally some young apple trees were also found ringed by these insects.

VII. THYSANOPTERA.

Thrips.—These minute insects are very commonly found in flowers of various kinds. They are not so commonly known to attack cultivated crops as other insects.

The following are some of our local species :—

(a) Garlic Thrips.

This is probably the same as the onion thrips in other parts of India.—*Heliothrips indicus*, **Bgl.** In September 1920 over an acre of garlic plants fairly full grown were found to be very pale and sickly without even a tinge of green matter in the whole area of plants due to the attack of these insects. The whole crop looked as though irrigation water was withheld for a long period. Thrips were found in very large numbers in all stages of development. The insects were found gradually spreading out to the adjacent plots also. A good spraying with ordinary soap water was tried without success in putting these down.

(b) Paddy Thrips.

Bull. Ent. Research, Vol. VI, p. 353-385. This is probably "Thrips oryzae". This insect was very bad in a number of seed beds of paddy in Maddur (Mysore District), in September, 1920. The plants were looking quite dry with a light blue colour mixed with brown from a distance, owing to the dense masses of thrips found on the plants.

Water was allowed to stand in the plots to a depth of 3 to 4 inches. A small quantity of kerosene was poured. After the oil formed a thin film on the water surface the seedlings were disturbed by means of thin long sticks. The water was drained off after about 18 hours

and after disturbing the plants a second time. Within a week the plants showed signs of recovery and were transplanted.

(c) Orange Thrips.

Thrips were found very bad on orange leaves and fruits in an orchard several years ago in March-April. The leaves were looking pale and discoloured, the fruits had small circular discoloured patches — at first pale and afterwards rusty coloured — on the rind. Young fruits dropped off as a result of the attack. Spraying with a tobacco extract was given, the result being, the attack of the insects on the fruits became more marked, instead of circular discoloured patches, circular depressions began forming and even big fruits began dropping down. The thrips-attacked leaves too dropped off in large numbers. It is possible there are other destructive species in Mysore, which we have not yet noted.

Potato Cultivation at Masti, Malur Tk., Kolar Dt.

Mr. M. Srinivasiengar, Landlord, Masti, Malur Taluk, Kolar District, gives the following particulars about his potato crop :—

Nature of soil	..	Light sandy loam.
Area planted	..	20 *guntas* or ½ an acre.
Date of planting	..	15th September, 1921.
Date of harvest	..	25th December, 1921.

Cost of Cultivation, etc.	Rs.	A.	P.
Digging with *guddalies* to a depth of 1½ ft. ..	10	0	0
Ploughing with a country plough and a pair of bullocks, 4 days at 8 as. per day	2	0	0
Value of 20 cart-loads of cattle manure mixed with a large quantity of potter's ash, at 2½ cart-loads per rupee	8	0	0
Carting the manure to the garden	3	12	0
Value of seed potatoes, 17 maunds at Rs. 3–8–0 per maund	59	8	0
Planting expenses—men coolies	7	0	0
Removing weeds and sundry expenses	1	12	0
Digging out the potatoes	3	0	0
Total expenditure ..	95	0	0

Produce, 104 maunds of potatoes, sold at Rs. 2–8–0 per maund	260	0	0
Net income from ½ acre of potatoes	165	0	0

This works at a profit of Rs. 330 for three months, or an average net income of Rs. 110 per mensem which is undoubtedly a decent one. A permanent labourer on Rs. 9 per month was employed ; his wages are not taken into consideration as his services were variously employed. The main source of water-supply is a tank.

The Cultivation of Tobacco Plants.

After transplanting, frequent working of the soil is the secret of the best results. To keep the field clean from weeds alone is not sufficient to ensure first class tobacco. The first cultivation should take place with the hand hoe eight to ten days after the plants have been set out. Fairly deep cultivation is desirable in the first instance, but as the plant grows care should be taken not to hoe too deeply. Tobacco which is grown under irrigation should be cultivated after each watering, as after "topping" the plant cultivation should cease.—*The Agricultural Gazette of New South Wales, Vol. XXXII, Part* 12.

The Clean Milk Can.

Unless some unusual food has been eaten milk is delivered from a healthy cow free from taint. It is also free from undesirable germs. Between the cow and the consumer it picks up a multitude of the latter and sometimes more or less of the former. The milk can is a common source of both. Minute particles of organic matter get into the seems or joints of the can, where they become the habituation of countless germs. Disagreeable odours arise as a result of the decompostion which ensues. Put your nose into the mouth of an empty can after it has been cleaned and ready for use — it is never entirely free from odour. But there is a distant difference between a "clean" smell and a "foul" smell. The enclosed air in a perfectly clean can will not smell like that which comes across the meadow, but it is sweet and not disagreeable. Fresh air and sunshine being death both to odours and to germs, there is a close relationship between clean milk and sunning of utensils.—*Live-stock Journal.*

Results of Plough Trials

BY

Gundappa S. Kurpad, B.A.,

Vice-Principal, Mysore Agricultural School.

Comparative trials were made with the Hebbal, Verity and Kolar Mission ploughs on the land which was hitherto being used as a play-ground by students. This land had never been ploughed before. Each plough was worked for an hour and the extent of land ploughed and the wear on the plough was noted. The land being very slopy the conditions were not quite the same all through. The same pair was used with all the ploughs. The Kolar Mission was first tried, then the Hebbal plough and then the Verity. This and the difference in the amount of moisture in the land may partially explain the difference in the amount of land ploughed in one hour. The relation between the amount of land ploughed and the wear of the shares will be ascertained by further trials during the next ploughing season.

	K. M. plough	Verity plough	Hebbal plough
Condition of land	Sod land in good condition for ploughing	Sod land a little dry	Sod land a little dry and hard in places.
Weight of plough	48½ lbs.	83½ lbs.	60 lbs.
Inversion	Good	Very good	Good
Pulverization	Good	Good	Very good
Furrow slice	8″ x 5″	10″ x 6″	8″ x 5″
Draught	3 cwts.	3½ cwts.	2½ cwts.
Resistance per square inch	8.4 lbs.	6.5 lbs.	7 lbs.
Area ploughed in I hour	4000 sq. ft.	4000 sq. ft.	3500 sq. ft.
Wear of share in I hour	1-16 inch	1-16 inch	1-12 inch
Length of point available per share	1½ inches	1½ inches	10 inches
Cost of share	Rs. 3—8—0	Rs. 4—2—0	Rs. 0—12—0
Weight of bullocks used	2000 lbs.	2000 lbs.	2000 lbs.

CORRESPONDENCE.

To

The Editor, The Journal of the Mysore Agricultural and Experimental Union, Bangalore.

Sir,

In view of the discussion on Gomal lands at the last annual meeting of the Union, an article on Fodder Grasses published in the *Poona Agricultural College Magazine* for March 1922, will be of interest to your readers. The concluding paragraph which shows what could be done for Gomal runs as follows :—

"As an instance of the value of co-operation it may be quoted here that at Pimpalgaon Baswant, a village in Nasik District, a *kuran* of 800 acres is being managed with success by the co-operation of the land-holders. Every year 200 acres are set apart for grazing for the cattle of the landholders of the village and 600 acres are harvested for hay which not only suffices for the whole year to the cattle of the village but every year there is also some surplus quantity which is sold to those having cattle but no lands and this amount of money is utilized for the public good. So when it is possible in one case it must be so in other cases too, with, at the most, some modifications if necessary according to the locality."

I have the honor to be,
Sir,
Your most obedient servant,
Gundappa S. Kurpad,
Vice-Principal.

Experimental Farm,
Hebbal.

Every Farmer should be an Experimenter.

"Every farm should have its experimental plot, and every farmer should be an experimenter in a small way. Government experimental farms can solve problems in a general way, and the value of their work is inestimable ; but farms differ, as do various fields on the same farm, so the problem becomes, at last, a personal one for the individual to solve."

The Farmer's Advocate.

NOTES AND COMMENTS.

Types of Mysore Cattle—1.

We are publishing as *frontispiece* to this issue a reproduction of a Hallikar bull. This bull was purchased by Government and the Hassan District Board from Mr. N. Krishna Iyengar of Uragahalli and is now standing for service at the Hassan Veterinary Hospital. This bull represents a very desirable type, and is reproduced for the breeder to carry in his mind's eye as a proper ideal towards which to aim. Noteworthy are his strong back and loins, neat shoulders, deep well-turned barrel which indicates room for lung expansion, and masculine appearance. Such an animal carries an appearance of prepotency, and is one which could be reasonably expected to impress his characteristics upon his offspring. This he has actually done on his offspring in Hassan, and although the calves born to him are all under a year old, those that have been properly cared for, carry most of his characteristics and show marked superiority over their rather indifferent dams.

The absence of excessive dewlap, and the thin and non-pendulous sheath are also among the good points of this bull. By breeding to a bull such as this is, an improvement in the local stock is a certain result, and we commend to our readers the use of such good bulls, whether they be privately owned or maintained by Government agency.

This is the first of what is intended to be a series of photographs of live-stock. We trust that these will be of interest and instruction to our readers.—[W.D.]

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The Effect of Feed on the Composition of Milk.

One hears many statements made regarding the effect of different feeds on the quality of milk from cows to whom they are fed. One man upholds cotton seed as an insurance of 'rich' milk, while another condemns, say, ground-nut cake, as a certain cause of poor milk. Numerous experiments have been carried out in various places, all of which point to the conclusion that the influence of feed

on the composition of milk is slight, when given in sufficient quantity.

An interesting report* of such an experiment has just come to hand, which is worthy of notice in this connection. Goats were used as the experimental material, and a variety of feeds of different compositions were fed. Rations were compounded to give high fat, high protein and high carbo-hydrate contents and tested against normal rations. Periods of starvation were also introduced into the feeding periods.

Briefly, the conclusions which the experiments draw, and which go to support conclusions drawn from previous experiments to throw light on this point are :—

1. The percentage composition of milk seems to be determined by its rate of secretion.

2. The percentage of protein, fat and ash vary inversely, and the percentage of lactose varies directly as the daily volume.

3. Diet has no direct influence on the percentage composition of milk, except in the case of non-proteid nitrogen, which is not a product of the mammary gland.

4. A high proteid diet would appear to stimulate the rate of secretion of milk.—[W.D.]

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Ammonium Sulphate as a Weed Killer.

Recent trials made at some places in England, in the way of eradicating weeds from corn fields are of interest inasmuch as a crop fertilizer has been used against the weeds, in place of the usual poisonous substances, such as copper sulphate. The corn fields were sprayed with solution of ammonium sulphate (1 to 2 cwts. dissolved in water and made up to 60 gallons which will be enough for $1\frac{1}{4}$ acres). The stronger solution was very effective in checking the weeds and within a week, its stimulating effect on the cereal crop was obvious. In the light of these experiments it will be highly interesting to consider the weed problem of our sugarcane fields. As stated before in this Journal the use of ammonium sulphate as a manure for sugar-cane

* The Effect on the Percentage Composition of the Milk (*a*) Variations in the Daily Volume and (*b*) Variations in the Nature of the Diet. By William Taylor, M.D.,D.P.H. (Carnegie Research Scholar) and Alfred D. Husband, A.I.C. (From the Rowett Research Institute, Aberdeen.) Published in the Journal of Agricultural Science, April 1922.

"is becoming popular, slowly but steadily." It has also been noted that the application of ammonium sulphate as manure promotes the growth not only of sugarcane but of the weeds as well. It will be interesting to try the use of ammonium sulphate as a spray against weeds in our sugar-cane fields, in order to see at the same time if it has any beneficial effect on the crop as well.—[M.J.N.]

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Use for Casein.

Referring to the uses of Casein and skimmed milk, it has already been pointed out in the pages of this Journal that skimmed milk can be utilized for fattening poultry and for feeding calves. It is interesting to note that both Casein and skimmed milk—preferably the former — can be used as adhesives in mixtures sprayed against diseases of plants. Experiments have been conducted both in the laboratory and under field conditions to test the efficacy of Casein as an adhesive. Casein added to the Bordeaux mixture, when sprayed against the *koleroga* of *supari*, has the property of making the mixture adhere well to the surface of the nuts, and thus prevent the disease, in spite of the heavy malnad rains. The work carried out in this connection will form the subject of a note in the next issue of this journal. With the increase of spraying work in the *malnad*, the demand for Casein will be large, but it is not possible at present to say if the demand will be large enough for the quantity manufactured locally in Bangalore. At any rate our requirements of Casein for next year's spraying work may be about a ton.—[M.J.N.]

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Sugar-cane Borer.

We are glad to be able to announce a simple and effective method of controlling this pest. It consists in trapping the moths that come to the young cane field, in small heaps of cane trash placed in appropriate situations in the field itself. The moths hide in these and are easily collected and killed in the day time.

Trials were made on the Babbur farm where a damage of 40 to 50 per cent was usual. This year it has been reduced to as low as 5 to 2 per cent whereas at Madivala about 4 miles off, 40 per cent damage was noticed. On the Nagenahally farm results are equally encouraging but figures are not yet available.

One interesting feature of the remedy is that all species of moths attracted to cane fields can be caught in the trash. The white borer moth is an exception but this is found conspicuous in the young canes and is easily caught by the hand.

The remedy as tested requires a man to go over the trash heaps daily for about two months. Experiments are in progress with two traps made of trash which will not allow the moths to go out once they get in. These, if successful, will simplify the remedy still further.

Attempts were made to find out the distance to which the moths fly in the night. Moths coloured red were let loose from about a mile from the cane field but none have been yet taken in the trash heaps in the cane. Experiments are being continued but observations show that they are quite capable of flying over distances of a furlong and more.

The life history of three of the borers commonly found has been completed and light has been thrown on a number of obscure points in connection with the pest. It is now known where the pest starts from and why there is little or no difference between a plot where 'dead hearts' have been removed and its check. Explanation of these and other points is reserved for a bulletin.

The remedies so far suggested against the borer in India and other parts of the world have been proved to be ineffective or impracticable and attention has been for some time concentrated on parasites as means of control. While it is not likely the remedy now devised will be applicable to canes in all parts of the world, there is reason to believe that it will be quite effective in India where, according to Mr. Fletcher, an annual loss of Rs. 30,000,000 is caused by this pest.—[K.K.K.]

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Our Annual Meeting.

It is expected to hold the annual meeting in November as usual and the exact date will be intimated by the Secretary in due course. We hope that members who undertook to conduct experiments as settled at the last meeting will bring up the results for discussion. We need not say that papers other than those embodying the results of such experiments are equally welcome.

SELECTIONS.

I.

The United States' Outlay on Progressive Agriculture.

According to the Yearbook of the United States Department of Agriculture for 1920, the Department's estimates of expenditure for the year ending 30th June, 1922, aggregate nearly 42 millions of dollars, an increase of 10 million dollars over the appropriation for the previous year.

This huge increase is taking place, notwithstanding a substantial reduction in the commercial value of the primary produce of the States. The farm output of the country in the year 1920, produced at an abnormally high cost, was actually worth 3,000 million dollars less than the smaller crop of 1919, and 1,000 million dollars less than the still smaller crop of 1918.

The American evidently considers that a falling market is the occasion for increased activity on behalf of his primary industries, and strange to say, in the face of the reduction in value (not in quantity) of his produce, actually comtemplates the erection of new buildings, the increase of the staff, and improvement of the equipment of the whole vast service.

Agricultural Gazette of N. S. W., Vol. XXXIII, No. 6.

II.

The Pure-bred Dairy Sire.

Much has been written regarding good sires since the special pure-bred sire campaign was inaugurated; great good, no doubt, resulted therefrom to the live-stock industry of the dominion. Improvement with good sires is more easily discerned in some classes of live-stock than in others. The poultry man aims for more eggs, the race horseman for more speed, the dairy man for more milk and butterfat, without sacrificing type. The effects of sires used for this purpose can be easily comprehended. One dairy sire may leave heavier producing daughters than their dams, while another may decrease the production of his daughter below that of their dams.

At the Agassiz Experimental Farm ten grade daughters of Inka Sylvia Beets Posch-5563-have just recently completed their two-year-old lactation periods. These ten heifers averaged 668·5 pounds of milk more than their dams did at the same age, and 1,004·5 pounds of milk

more than their dam's dams at mature cows. This is another of the many instances on record where pure-bred sires have done excellent work in a grade herd.

Any man starting in the dairy cattle business cannot afford to purchase anything but a good pure-bred sire. His breeding herd soon comes to the level of the bulls he uses rather than of the dams or foundation cows. Only six and a quarter per cent of the blood of the foundation cows remains in the herd after the third generation. He can better afford to go wrong purchasing his entire herd of foundation cows than to go wrong in selecting his herd bull. A poor cow transmits her characteristics to only one individual each year while the bull influences a large number. Poor production in a cow may be found out in a year and often less, but low production in a bull cannot be detected until his daughters are in milk and by that time he has transmitted undesirable characteristics to several crops of calves.

The most difficult and dangerous task the dairy man sets for himself is that of selecting a herd sire. He must secure a bull, keeping in mind type and production, and a sire that will nick with his females. A good bull will not always mate well with a good cow, the law of variation may interfere. If a young untested sire is to be selected, his pedigree is studied from the standpoint of production of all dams for several generations. If an old and tested sire is being selected, the records of his daughters are studied. The more tested daughters a bull has, the better he can be judged as a breeder. The percentage of high producing daughters and the opportunities given them are factors to be considered. The daughters should also be compared with their dams from the standpoint of type and records.

If you have a good bull and he is of no further use to you, sell him to a good breeder and not to the butcher. The more good heifers his new owners raise and test, the greater value may be placed on your animals.— *Seasonable Hints, No. 21., Department of Agriculture, U.S.A.*

III.

The Rest Cure for Soils.

It is a fundamental principle in crop rotation that once in every three, four or five years the land should be seeded down to grass. It is a fact well known to practical men that the longer the land is left in grass the richer it will become and the better the following crop of roots or grain will be. Just how the "rest cure" enriches the soil was not discovered until comparatively recently.

Bacteriology is a science that has come to the front within the last twenty years. It has shown us that the minute creatures known as bacteria are at once our friends and our enemies. In 1886, Heliriegal and Wilfarth announced that legumes enriched the soil through the agency of bacteria that they contain in the nodules on their roots.

It was not, however, until 1895 that the Russian scientist, Winogradesky, discovered that azotobacter and allied organisms, by using the energy contained in the organic matter were able to "fix" the atmospheric nitrogen. These bacteria are evidently one of the chief agencies by which the rich black soils of Southern Russia and the Canadian West have become so fertile and rich in nitrogen. By seeding down land to grass every now and then we are making these little organisms work for us, and are adopting nature's own way of building up the fertility of our soil.

When soils are becoming run down and are not given a rest, nature sooner or later does it for them by simply refusing to grow anything but weeds. There are many farms in America that years ago had to be abandoned on account of poor farming methods that are probably to-day, on account of the "rest cure" they have had, in high state of fertility, and would produce magnificent crops if they were once again put under cultivation.

A good example of how soils when given a rest and allowed to run wild will increase in fertility is afforded by some of the experiments conducted at Rothamsted. A piece of ground that had been growing wheat for a number of years was allowed to go out of cultivation. It soon covered itself with vegetation and weeds of every kind.

The nitrogen in the soil at the beginning of the experiment was determined, and again after a lapse of 22 years it was found that nitrogen was being added to the soil at the rate of about 90 pounds per acre per year. This is sufficient to produce 54 bushels of wheat.

A piece of land in another field was also allowed to run wild. After 22 years it was found that here nitrogen had been added to the soil at the rate of 60 pounds per acre per year. The soil in this field only contained 1·6 per cent of lime, while the soils in the other field contained 3·32 per cent. That is to say, the increase of nitrogen per year in the field that had the more lime was about one and a half times as great as it was in the other field. When plants in these two fields were examined it was found that the field that had the most lime grew more clover and other legumes. This partly accounts for their being more nitrogen gathered in the field rich in lime.

Legumes are not the only plants that can gather nitrogen from the air and store it in the soil. There are little micro-organisms of which one called azotobacter, and referred to above, is at present the best known to scientists, which can enrich the soil by "fixing" the atmospheric nitrogen. These organisms grow best and therefore "fix" more nitrogen when an abundance of organic matter and lime are in the soil. In a field of Rothamsted where wheat was grown year after year and no manure used, the soil got very deficient in organic matter with the result that azotobacter and other nitrogen fixing organisms did not develop well, and consequently, practically no nitrogen was being added to the soil. In land that is allowed to run wild an accumulation of organic matter takes place.

This organic matter furnishes the micro-organisms with energy whereby they can gather the nitrogen from the air, and a rapid accumulation of nitrogen in the soil occurs.—*Indian Scientific Agriculturist, Vol. 3, No. 6.*

IV.

Pepper Cultivation in Cambodia.

The soil selected for this cultivation is a slightly elevated land, either wet land or just above the level of the wet land. The texture of the soil is a fine loam and is of light colour. The greatest attention is paid to drainage and this is artificially improved by raising the level some four feet or more above that of surrounding fields by carrying soil to it. Ridges are then formed along the contour in such a way that the furrows have a very gentle slope thus no water at all is allowed ever to stand on the surface of the soil. If necessary these furrows are stepped, the steps being built up with dry stone. From crest to crest of the ridges the distance is 6½ feet and the height of the ridge from the top of the crest to the bottom of the furrow is about 1 foot Posts are planted along the crests of these ridges 6½ feet apart. Each post is about thirteen feet in length, three feet are sunk into the ground and about ten feet are above ground. These are of special timber which will not rot nor will it be attacked by white ants. Three different trees are used for these posts, but the only one which I was familiar with, was the "Irul", (ಏಲ್) *Xylia dolabriformis*, which is the same tree as is used for pepper crops on our West Coast.

The variety of pepper grown is quite different to that grown in India and is probably a different species. It never forms runners like our

West Coast varieties and the branches and internodes are stiff and short and stand out like our "Utherankotta" variety.

Whereas in Malabar only the runners are used for cuttings, here the ordinary bearing part of the vine is used and this cutting is cut right down to the old wood. The side branches of that part of the cutting which is to be below ground are removed and the length of the below ground portion is from 15–18 inches consisting of some eight to ten internodes. The part to be above ground may have three or four branches which are not removed, and the main stem may have some four or five well-formed internodes. Two or three of such cuttings are planted close up against the post. Planting is usually done in March-April, *i.e.*, at the commencement of the hot weather, and the cuttings are shaded till they establish themselves. Before planting a hole is dug at one side of the standard and the soil removed is mixed with about 2 lbs. of prawn skins. If necessary, the cuttings are watered. This is done by boring a hole in the ground in the vicinity of the standard and filling this with water. Surface watering is never done.

Subsequent cultivation consists of hoeing and weeding three or four times a year, though in none of the gardens visited were any weeds to be seen. So probably this was rather to preserve the soil mulch.

The vine commences to bear in the following year, though to no great extent. In three years it gives a good crop and in five to six years it has completely covered the pole. After that it may continue for 25-30 years. If the post fails the vine is carefully removed, a new post is planted and the vine replaced.

Although the vines seem to have a very strong aerial root attachment which concentrates in clusters at the nodes, the vines are very carefully tied. The bast from the bark of some tree is used and the vines are tied every three or four inches.

Each year at the commencement of the rains, each vine receives about 2 lbs. of prawn skins. This is buried in a trench at one side of the vine one year and on the other side the next.

This species of pepper gives two crops a year : One in March which flowers in November and the other in August which flowers in May. The heaviest crop is the March picking, which was in progress at the time of visit. At this picking each vine is said to give about 4 lbs. of dried pepper, but judging by the crop on the vines this is an under-estimate as I have never seen such heavy crops.

Harvesting commences when the berries commence to turn red, but most of those seen on the vines were red ripe. This is dried for two

or three days on a drying floor when the berries are removed from the stem by the feet of men treading them out. It is then winnowed in a winnowing machine, which is very much like the European machine to separate the light pepper.

White pepper is also made by grinding off the fruit coat but the best white pepper is collected in the surroundings of the garden by women and children from the droppings of birds which feed on the ripe berries. The white pepper is either disgorged or passes through the bird after the fleshy part of the fruit is taken.—*Year-book of the Madras Agricultural Department, for* 1920–21, *pages* 67—70.

V.

Sunflowers for Silage.

During recent years much attention has been attracted to the use of sunflowers as a new silage crop, and in some states sunflowers have been hailed as the solution to the corn problem. Investigations conducted in Wisconsin by E. D. Holden (Agronomy) during 1919, 1920 and 1921 show that sunflowers can be grown successfully under almost any climatic and soil conditions to be found in the state and that they yield a large tonnage of green material than any other silage crop. However, one of the most important questions yet remains unsolved, that is, the value of sunflower silage as a feed for dairy cows.

The 1920 crop of sunflowers grown on the University Marsh was cut on August 29, and September 1, when the plants averaged one-third in bloom. The lower leaves of the plants were dried up and brown, yet the crop was only slightly attacked by rust, and the freshly cut silage contained 83 per cent moisture. By cutting and ensiling the crop early and at a comparatively immature stage, it was planned to avoid, if possible, the tough, woody material frequently found in silage made from more mature plants. During the winter the silo was opened and some cows started on a part ration of the silage preliminary to a feeding test. Sunflower silage was somewhat more acid than corn silage from the field and contained a considerable amount of fibrous woody material. Although in a number of weeks' feeding the cows were induced to clean up more of the sunflower silage, they did not take to it readily but picked out the corn in the mixture.

Sunflowers grown at the Ashland Branch Station under the direction of E. J. Delwiche (Agronomy) during 1920 were put up in two plots, one from a cutting when but few of the plants were in bloom, the other

in full bloom. The silage from the later cutting proved to be unpalatable and of poor quality, and the cows ate it sparingly and fell off in milk production. Silage from the early cutting, however, was eaten readily by the cattle and with no decrease in milk flow.

Various reports from the farmers throughout the State have shown experiences quite similar to those at the Experiment Station. Some are discouraged in the use of sunflowers while others praise it as being one of the best crops they have ever grown.

Some prevailing opinions throughout the State seem to be :—

1. Sunflowers should be cut during the budding or early blossoming stage, that is, early enough to prevent the Stalks from becoming woody.

2. Mixed silage of corn and sunflowers often gives excellent results.

3. The crop is better when the corn and sunflowers are grown separately than when they are both grown together.

4. Generally where corn can be grown to good advantage as a silage crop, it does not pay to raise sunflowers.

5. In the upper part of the State sunflowers are proving very advantageous as a silage crop.

Sunflower Blight and Time of Cutting.— During the last three seasons both in our own fields and in those of many growers the lower leaves of the sunflowers planted for silage began to dry up and turn brown somewhat before or during the blossoming period, and the withering of the leaves continued up the stalks until the crop was cut. This condition is worse in a dry season than in a wet one and worse on high dry soil than on moist land. Under drought conditions late plantings are particularly affected by this blight ; in thick plantings the leaves begin to wither earlier and the loss of leaves is greater than in thinner planting. If the leaves are attacked by the rust the withering is hastened and is more extensive. Much of the evil effect of this blight can be prevented by early cutting, for the preponderance of poor silage comes from sunflowers cut when quite mature, while most of the good silage is made by ensiling during the early blossoming stage. Exceptions occur when the soil is rich and moist, but experience shows that the early cutting is desirable if the leaves are to be saved for palatable silage. Sunflowers planted at corn planting time or before may be ready the first half of August, while if they are planted in the middle of June or later, they may be cut during the first part of September.

Thickness of planting.— Inasmuch as the condition of the stalk and the freshness of the leaves greatly influence the quality of silage, the thickness of planting has considerable influence. The best results have been

obtained when the plants do not average closer than 6 inches apart in the drilled row. In the tests no difference in the condition of leaves could be seen between planting 6 inches and 10 inches apart in the row. Further, by cutting the sunflowers as short as possible with the silage cutter, the hard woody pieces of stalk which may otherwise appear, can often be avoided.

Corn and Sunflowers for mixed silage.—During 1919 and 1920 several fields planted to mixtures of corn and sunflowers were observed, but the results were rather unfavourable. Where the sunflowers formed a large part of the crop, the crop of corn was badly handicapped because of the rank growth and dense shade. The stalks became spindling and the ears small; many stalks did not bear any ears. Where corn was the major part of the crops and made a normal growth, the sunflowers were so few that the benefit of the greater yield of the sunflowers seemed largely lost, for the increase in yield hardly offset the extra labour required to handle the top-heavy sunflowers. Furthermore, the sunflowers arrived at the best stage for ensiling earlier than the corn so that if the crop was cut when the sunflowers were ripe, the corn was immature, while if cutting was put off until the corn was sufficiently mature, the sunflowers became woody and tough.

At the Marshfield Station corn and sunflowers drilled together in rows in three different proportions gave the following results:—

All sunflowers	.. ..	11.5 tons per acre
Corn and sunflowers, planted 1 to 1 by volume	..	11.5 „ „
Corn and sunflowers, planted 2 to 1 by volume	..	12.3 „ „
Corn and sunflowers, planted 3 to 1 by volume	..	10.7 „ „

Although the quality of the silage has not yet been tested the highest yield was noticeably from the plot where 2 of corn to 1 of sunflower seed was used in planting.

By following the practice of some growers who plant the sunflowers and corn separately, then mix them in ensiling, some of the disadvantages of growing the two together have been overcome. Another method, observed in two fields, was to plant two rows of each, corn and sunflowers, alternately. This was done by filling the hopper of the corn planter with corn and the other with sunflower seed. The corn in these fields made a normal growth, not suffering from the competition with the sunflowers as when the two were planted together in the row. By this method the bundles of corn and sunflowers can be thrown on to the same waggon from one side and the other, making it possible to secure a very even mixture in the silo. Some growers have planted corn and sunflowers

together even where corn can be grown, so that if the corn should be killed by an early frost, the sunflowers will still make good silage.

Sunflowers as an aid in weed control.—As a cultivated crop, sunflowers are very effective in controlling weeds, because of the cultivation in the early part of the season and the dense growth made by the crop in the middle and latter part. To increase the effectiveness of such control, some growers fallow the ground in the spring and early summer, planting the sunflowers, late along the first to the middle of June. At the Marshfield Branch Station a field was fallowed in the spring and early summer, sunflower seed being broadcasted at the rate of 45 pounds per acre, early in June. The sunflowers grew exceedingly dense, and inspection in July and August showed the ground to be absolutely bare of other vegetation proving the sunflowers to be a most effective smother crop. The yield of this broadcast field was 8.25 tons per acre of green silage material.—*Agricultural Experiment Station, University of Wisconsin, Madison Bulletin* 339, *February* 1922.

VI.

Value of Farmyard Manure in Crop Production.

So satisfactory have artificial manures proved that agricultural chemists have sometimes thought they represented all that there is in agricultural chemistry. Until very recently if a man proposed to speak on agriculture it was expected of him that he would praise artificial manures and fertilizers and disparage farmyard manure. Good farmers have always, however, insisted that farmyard manure has advantages over artificial fertilizers. Experiment at Rothamstead confirms this.

Fortunately the continued repetition of Lawe's and Gilbert's experiments year after year on the same ground has allowed of the accumulation of the data from which evidence as to other effects can be adduced. Wheat has been grown for 78 years with farmyard manure and with various artificial manures. A statistical examination by Mr. R. A. Fisher in our laboratory of all the data accumulated since 1852 shows that farmyard manure gives rather more regular yields than artificials; the fluctuations from season to season are not quite so marked, and although the farmyard manure never gives "record" yields, it also never does badly. Further, the plot fertilized with farmyard manure shows no signs of deterioration after 80 years of continuous cropping with wheat, while all plots manured with artificial fertilizers even the best show clear signs of deterioration now.

Farmyard manure further appears to have a greater effect than artificials in increasing the growth of the clover. Unfortunately, the number of experiments on this is not very great, but the results are consistent, and the good effect is shown not only in the clover but in the succeeding wheat crop :—

	After farmyard	
Clover, 1917, Cwt. per acre	62.1	46.2
Wheat, bushels of grain per acre	45.1	37.1
Wheat, Cwt. of straw per acre	45.3	36.9

Again, farmyard manure produces effect on root crops, and particularly on mangolds, which artificials will not. On the Barnfield at Rothamsted there are 26 plots receiving artificials only, and 10 receiving farmyard manure. Up to the end of July the dunged plots stand out in sharp contrast with the others, showing a vigour of growth produced by none of the artificials.

All these facts (and others which might be adduced) go to show that the first generalization with regard to farmyard manure, *viz.*, that it owes its fertilizing value to its nitrogen, potassium and phosphate, does not express the whole truth. It has a large measure of truth and much pragmatic justification ; it has given us our artificial fertilizer industry and in addition, a great deal of our present agricultural chemistry ; but there is something in farmyard manure which is not covered by this degeneralization. Attempts are therefore being made to find out what causes these further properties: we are now seeking a second approximation.

Effect of accessory substances.—It is of course possible that there are chemical constituents in farmyard manure which are essential or highly desirable to plants, but not present in our artificial fertilizers. The old idea that nitrates, potash, and phosphates suffice for crop growth may be wrong. This aspect of the subject has been investigated in France. G. Bertrand began it by classifying it apart the "*engrais complementaires*" which in present day terminology would be called accessory substances. Manganese, fluorides, copper, have all been considered effective by the French workers. Recent work by Maze in Paris and Dr. Brenchley at Rothamsted suggest that small quantities of boric acid may cause distinct increase in crops fully fertilized with artificial manures. We cannot as yet recommend farmers to adopt this kind of manuring with special substances, because it is very easy to overstep the beneficial limits and then much damage is done to the crop ; the effect rather seems to be in the nature of a stimulant than food, and the plant suffers from excess just

as surely as a man would do. However, it may prove possible to keep these effects within reasonable bonds and to ensure the same degree of control as we now have in the case of artificial fertilizers.

Other effects.—There is evidence that the cellulose in straw (which as litter constitutes about three-quarters of the dry matter of farmyard manure) may be responsible for the special farmyard manure effects. It seems possible that the cellulose or some of its decomposition products may exert a special on the micro-organisms living in the clover root causing an increase in the amount of nitrogen fixation, thus giving larger clover crops, and further enriching the soil in nitrogenous organic matter.

It also seems possible that certain decomposition products of cellulose are responsible for the remarkable physical effects which farmyard manure is known to exercise on soil, causing it to become puffed up so that the empty pore spaces in size. The air supply to the roots thus becomes better, the water supply becomes evenly regulated, the work of the tillage implements become lightened and a good tilth is more easily obtained. The plots at Rothamsted receiving farmyard manure contain always some 2 to 5 per cent more moisture than those receiving no manure or artificial only, and this enables the mangolds, to keep growing during a drought which effectually checks all plants not receiving farmyard manure.

Lastly, there is a clear relationship between supplies of farmyard manure and the population of micro-organisms in the soil. The importance of this population to the growing crop is only now being realized. It is known, however, that the farmyard manure and the green manure we put into the soil are not really agents of fertility but only raw materials out of which fertility is manufactured. The work is done by the myriads of living organisms in the soil, and their activity is increased by the presence of farmyard manure.

Four possible explanations.—There are thus four possibilities to be investigated in regard to farmyard manure :—

1. Some of its constituents other than the recognized nitrogen, potash and phosphate may prove of value to the growing plant.

2. The cellulose or some decomposition products may exert a special action on the nitrogen-fixing organisms in the roots of leguminous plants.

3. The decomposition products of the cellulose may profoundly modify the colloidal character of the soil, thereby changing its physical properties.

4. Farmyard manure influences the micro-organic population of the soil.

Work in all these directions is proceeding at Rothamsted and elsewhere. It is clear that the problem is much broader than was envisaged by the older chemists; in addition to the one factor which they studied so thoroughly, there are now known to these four others which we have still to work out.

A good beginning has been made in the study of soil-micro-organisms, and already we understand something of them and their work. There are two main lines of decomposition of interest to the agricultural chemist. One is the decomposition of cellulose with ultimate production of the black material known as the humus: the other is the conversion of the protein and other nitrogen of the soil to nitric nitrogen.

The first change is only slightly understood; a plausible assumption for which there is some direct evidence, is: Cellulose, Levulose, hydroxymethyfurfuraldehyde, which in presence of acids, *e.g.*, amino acids, condense to form humus. The second change is better understood. The complex compound breaks down to form ammonia which oxidizes to nitrites and finally to nitrates. The agents bringing about the change are bacteria, and probably certain fungi: the production of ammonia is a widely spread property; it is not usual to identify the organisms concerned, but only to count them. The production of nitrate and nitrite is more specific and is confined to two or three species. Nitrates are an essential plant food and their production is indispensable to plants. But the population is very mixed and some agents presumably some of the organisms remove part of the nitrate as soon as it is formed, either decomposing it, or more probably assimilating it and converting it into protein. Much light has been thrown on this process by a new method of investigation now in use at Rothamsted. Samples are taken from the field every two hours and determinations are made of the bacterial numbers and the nitrate. In the earlier work the ammonia was also determined but its amount was always so small and so little subject to variation that the estimations were discontinued. In the cases so far examined the bacterial numbers and the nitrate show marked fluctuations, the nitrate following up the bacteria and down with a lag of about an hour.

The cause of the fluctuation in nitrate is the fluctuation in the bacterial numbers: the experiment throws no light on the reason for this, but information is obtainable from another experiment. Counts have been made daily of bacteria and amoebae in the soil for a period of 365 days; both fluctuated, but always in opposite directions — when the amoebae were high the bacteria were low, and *vice versa*. Presumably the fluctuations in the bacteria are caused by the fluctuations

in amoebae ; but why the amoebae should fluctuate we do not know ; perhaps they are affected by some other organisms in a way not yet known to us, or perhaps there is some internal cause.

While the upward movement of nitrate is the direct result of the upward movement of the bacterial numbers the downward movement can hardly be the direct consequence of the fall in numbers ; presumably it is due to the operation of a destructive factor or an organism such as had to be postulated to account for the other Rothamsted results. It was found that the production of the nitrate in the soil goes on steadily year after year when there is no direct addition of any nitrogen compounds to the soil ; the stock of complex nitrogen compounds originally present seems sufficient to last for a very long time. Nitrate is being washed out from the drain gauges at an apparently uniform rate of 1 lb. of nitrogen per inch of rain, although for 50 years no nitrogen compounds have been added to the soil. No known hydrolysis of protein compounds could produce ammonia in this way, and the results lead to the conclusion that part of the nitrate formed at any time is assimilated by micro-organisms, converted into protein, and then reconverted into ammonia and nitrate when they die. Recent work suggested that the amount of nitrate assimilation is much greater than was suspected. In a single day the amount of nitrate produced corresponded to 35 parts of nitrogen per million of soil, or 80 lbs. nitrogen per acre — as much as is required in a whole year by a 45-bushel crop of wheat ; but in consequence of the destruction also going on, the whole of this nitrate had disappeared before the end of the day and the net gain was *nil*.

There is reason to suspect that algae may be concerned in the removal of nitrate — which in this case would be by assimilation, but other organisms may operate also ; the matter is receiving close attention at Rothamsted. From the point of view of microbiology it is of course essential to investigate as fully as possible these remarkable relationships.

Besides these organisms concerned in the nitrogen nutrition of the plant, there are others that affect the health of the plant, causing injury or disease. We must now look upon the soil population as being both numerous and varied.

From the practical point of view it would be an obvious advantage to be able to control this soil population, and a beginning has been made here also. It is found that an improvement in fertility is obtainable when the soil population is simplified, as can be done partial sterilization by steam or organic poisons. The difficulty that the soil might

become sterile through the action of the poison on the plant is obviated in practice by the interesting fact that certain of the soil organisms possess the remarkable power of decomposing such unlikely substances as toluene, naphthalene, phenol, cresol, and apparently even the chlorcresols, rendering them innocuous to the plant. These problems are all receiving attention at Rothamsted and elsewhere.

The rest of the four problems arising out of farmyard manure are also receiving attention, and already the scientific interest is considerable. We cannot help wondering whether these new problems associated with the nutrition of plants; the elements needed in minute quantities only; the influence of cellulose or its decomposition products on nitrogen fixation; the effect of farmyard manure on the soil population and on the soil colloids — whether these will turn out to be as important as the one that filled the vision of the 19th century workers: and whether when developed they will lead to the establishment of great industries like the artificial fertilizer industry, and to great agricultural developments like those resulting from the use of artificial fertilizers. The signs are hopeful, and there seems to open before us a vista of possibilities which, if we could but grasp them, would heal many of the ills from which we are now suffering.—*The International Sugar-Journal. Vol. XXIV, pages* 113—168.

VII.

Co-operative Consolidation of Holdings in the Punjab.

There has been so much written about the evils and drawbacks of excessive fragmentations of holdings that the subject needs no introduction. In the Punjab the average holding is somewhere between six and fifteen acres; the actual figure depends on whether holdings of less than one acre, and holdings attached to houses, etc., are omitted. This holding is sufficient to maintain a family in decent comfort if the right crops are grown, if the land is put to the best use, if adequate capital is invested and if several other conditions are fulfilled. But for these small holdings, it is essential that the fields should be concentrated in one place, so that the attention, the time, the energy and the intelligence of the cultivator may also be concentrated there. In this Province, however, custom orders otherwise. The land is held by the owners of villages either by ancestral shares or by actual possession on the ground: the tendency now-a-days is for an owner's rights to be measured by the

actual area in his possession, plus a share in the village common, or *shamilat*. The universal custom is for sons to inherit equal shares, except where there are sons by different wives, when it sometimes happens that sons of each wife inherit an equal share and divide amongst themselves. These shares may be held in common, the brothers arranging amongst themselves the fields each shall cultivate or even cultivating in common and sharing the produce. There is a strong tendency, however, to each brother, especially when he begets a family, to take his own share as his separate property and to leave his brothers alone in the management of their own shares. There is no custom, such as is found in Europe where the code Napoleon is in force, of the elder brother buying out the younger and so becoming sole proprietor of the ancestral land. The effect of these tendencies is for the land to be held in smaller and smaller parcels; and, as on partition amongst heirs each claims and expects to get a share in each kind of land, each owner becomes possessed of a number of fields scattered throughout the area of the village. In these portions of the province, where the crops were more secure owing to the rainfall being more assured, this fragmentation has proceeded to a greater extent than in districts with precarious rainfall, where a small scattered holding would not have sufficed to maintain a family. Perhaps, this tendency has gone further in Jullundur than in any other district. Jullundur is in the Central Punjab; its fertility has led to the growth of a large population pressing heavily on the soil; the facility with which wells can be constructed has led to the land becoming largely dependent on this form of irrigation; the forces making for fragmentation have under these circumstances produced some startling results. In eight villages, the average field does not exceed one-fourth of an acre in area; the 2,549 owners possess 12,800 acres, or about five acres each, but these 12,800 acres are divided into no less than 63,492 fields, so that each owner has on the average 25 fields. In one village 584 owners own 2,353 acres in 16,311 fields, the average being one-seventh of an acre. In the neighbouring districts of Hoshiarpur and Gurudaspur the process of fragmentation has resulted in similar conditions. In the rest of the province, outside the great canal colonies, somewhat similar features are to be found, though not to so marked an extent. In Jullundur, owing to the successive partition of holdings, shares in wells have also been divided, so that a man may own a one-sixteenth of one well, and one-eighth of another and so on. The economic loss due to this system may be imagined.

The evils of fragmentation are obvious; the remedy is not so easy to find. It so happens that the three districts mentioned are those in

which co-operation has made progress, and in which the co-operative spirit has been best developed. It occurred to me that a solution along co-operative lines might be found which would prove acceptable to the cultivators. To this end, I pronounced a scheme and discussed it with co-operators and the staff at various meetings; as a result model by-laws were prepared with an explanatory note, and efforts were made to persuade owners to give the scheme a fair trial. It was essential that the experiment should rest upon a voluntary basis, for the simple reason that there were no powers of compulsion; at the same time it appeared necessary to insert a provision for decision by a majority in case one or more owners turned obstructionist. The scheme put forward was as follows:—Each owner had to agree to the desirability of consolidation, and the general idea of repartition of the village lands with this end in view; each such owner had then to agree to abide by any plan of repartition approved by two-thirds of all the owners; and further to give up possession of his own lands and to accept in exchange the lands allotted to him; all disputes to be referred to arbitration; possession so given was to be cultivating possession for four years only, on the expiration of this period, the former possession was to be restored unless all the participating owners unanimously agreed to retain the new division as permanent ownership. Persons accepting these conditions could form a Co-operative Consolidation of Holdings Society. The general meeting would discuss the method of partition and decide on the main principles to be observed, such as the kinds of lands, the relation of former possession, and whether minor differences as to trees, etc., should be made good by money payments, and so on. In the case of any difference of opinion, any resolution would only be binding if two-thirds of the members approved of it. If there were not all the two-thirds of the members in favour, then it would be necessary to devise some alternative method, or the society would dissolve. When a method of partition had been decided upon, the managing committee was to proceed to draw up a scheme of partition in accordance therewith. This scheme was to be placed before the general meeting; if two-thirds of all members accepted it, it would be binding on all, otherwise it was to be discarded. If a scheme received the approval prescribed, members were bound to give up and accept possession in accordance with it. A member, who felt aggrieved, could refer the point in dispute to arbitration. Members, thus exchanging lands, would be tenants for four years; during that period, any, who chose to convert this temporary possession into permanent exchange of ownership, were at liberty to do so; and it was intended and hoped that many, if not most, would do this before the four years

elapsed. At the end of four years, members would have to decide whether they would revert to the former possession or make the new scheme permanent or retain the temporary arrangement for a further period. Failing complete unanimity, the fields were to be restored to the former owners and the society would automatically come to an end at the end of five years. The extra year allowed for the settlement of disputes by arbitration was also given.

Under this scheme, a member only bound himself for four years; he agreed by the decision of two-thirds of all the members as to the mode of partition, and by a similar majority as to the actual partition on the ground. He could not be deprived of his old fields beyond four years without his own consent, as an unanimous vote was necessary to convert the exchange into a change of ownership.

This was the scheme. In placing it before the people, the staff relied upon preaching and persuasion, and not upon the element of compulsion. The people soon came to see and appreciate the advantages but every one feared that he, at least, would lose by giving up his own very precious fields for a someone else's inferior ones. It was obvious that, if a revolution of this nature was to be carried through on a permament basis, every one must be satisfied and no one must be left discontented. It might be possible to repartition one or two villages by catching the hesitant over the compulsory clauses; the general idea would fail if there were any disgruntled to decry it through the neighbourhood.

With such considerations in view, the power of compulsion by two-thirds majority has so far never been used; if any one objects to one plan another is tried and so on until every one is satisfied; in one case at least the staff were too anxious for results, and paid too little attention to objections with the consequence that the owners refused to have the decision ratified when it was placed before the Revenue Officer.

Now for the accomplishment. The staff of the Co-operative Department are for the most part sons of actual cultivators, and so in sympathy with rural feeling; the inspectors are now generally graduates who study practical applied rural economics in the ordinary course of their studies; they exercise no legal powers at all; they have to rely upon their powers of propaganda and persuasion; they are specially educated men speaking to their brethren with knowledge begotten from careful training.

In all 69 Societies for the Consolidation of Holdings have been registered; each society has been organized in a different village, but t is not always the whole village that is put to repartition at once.

Sometimes a block of land is tried as an experiment, sometimes a subdivision, sometimes the whole area. (It is of special interest to note that, in several villages where only certain blocks are first readjusted, the owners of other blocks are now asking for help in readjustment.)

In 45 villages complete or partial repartition has been concluded, in 39 cases the repartition has been confirmed before the Revenue Officer (mutation has been sanctioned), and the change incorporated in the records: in the remainder, mutation is pending until the officer visits the village. The gross result is that 1,653 owners, who formerly possessed 8,100 acres in 10,906 fields, now have this land consolidated into 2,071 fields.

The reduction in field numbers exaggerates the effect, as in many cases an owner had previously two or more fields contiguous: but there can be no doubt that the scattered holdings have been changed for solid blocks. The average size of a field before consolidation was three quarters of an acre; now it is four acres. In eleven of these villages, before consolidation, the average size of a field in each village was not more than half an acre: now it is less than one acre in only one case, and less than two acres in two more cases.

In nearly all cases, the exchange of possession has been made permanent from the start. This was not advocated from the fear that a measure too revolutionary might not be found acceptable at first. As a matter of fact, when the owners have got so far as exchange of possession, the plunge into permanency is robbed of its terrors.

Of the economic results, it is too early yet to say much. Prosperity is not built up in a day: but the reports received show already some changes. In one village it has been possible to get rid of a guard (*rakha*) over the crops, thus saving a sum equal to a considerable portion of the revenue charged on the land. In Ghazikot rents have increased for the compact blocks, as the tenants find these more easy to manage. In this village the consolidation has created parcels of land which can be irrigated from a well; previously fields were on the average three-quarters of an acre in area, now the average is over four acres; the former is too small to justify a well, the latter is large enough to make one profitable; already six new wells are under construction. Another advantage is discovered; with larger fields, there is much economy of canal water. To irrigate a number of petty scattered fields involves a waste of water as it has to be carried over a number of channels; with a consolidated holding this source of waste diminishes. In another village it is proposed to plant fruit trees on portions of new parcels of land.

In some cases it has been found that the fields were actually too small to make cultivation worth the trouble involved, and were left untouched in consequence; this difficulty has now disappeared. In one village the owners, after consolidation had given them compact parcels, bought Meston ploughs. These ploughs are not handy for the very small fields, but this difficulty does not remain when the fields are large.

Of difficulties much could be written. Every owner fancies his ancestral plots are the best and dislikes the idea of exchange; old men hate to be disturbed, minors require special consideration; the very small owners see no advantage, the bigger men have sometimes got more than they are entitled to and repartition would take this away; mortgages oppose any alteration, and occupy tenants fearing that their rights will be lost if their possession is disturbed; some owners have migrated in search of work and their consent cannot be obtained. All these must be met with patience and tact. Other difficulties are of a different order; the village patwari sees his income from disputes, from copies for court use, and from other little sources threatened with reduction; he also fears that with compact holdings the number of patwaris will be reduced and his conscience suggests that, if the worst men are dismissed, he will not be a survivor. The higher revenue authorities have shown much interest in the work, and as success is achieved, this interest should grow.

The most important feature about the work done is that it has been shown that consolidation can be carried out in actual practice; the stage of discussion and opinion and pious resolution has been left behind. A beginning has been made, a small beginning, perhaps, but still a beginning, which is better than none at all. The year's work marks a definite step forward.

The work demands the utmost sympathy and patience; nothing must be rushed, nothing left unexplained; every man's objection must be removed, even if he be the smallest owner in the society. A village well satisfied with its experiment in consolidation will be of more value for propaganda than many lectures. The cultivators readily grasp the advantages; each is ready to take his neighbour's land, but not so ready to give up his own. The main elements of co-operative action must be carefully preserved. The agreement to join in such a society must be voluntary and based upon the realization of a common need and of the desirability of securing it by common action. Within the society, every one, be he a big owner or a small one, must have an equal voice; the smallest man may make the loudest complaints; the executive work must be entrusted to an elected committee but this must be answerable to the

general meeting; no one must seek advantage at the expense of his neighbour. The time for any element of compulsion from Government has not yet arrived; there must be a long period during which the measure gains in popularity and acquires the confidence of the majority: public opinion in its favour will grow as more and more instances of the practical advantages can be published abroad. Unless the unexpected happens, years of steady persistent propaganda will be required before the evil of fragmentation has been scotched.

We are not prepared to advocate any legislation at this stage; it is probable that several steps will prove necessary in succession. At present, there seems to be desirable some measures of protection of minors and their guardians, especially of the guardians: it may, for instance, be necessary to provide that an act of consolidation approved by a guardian and by the general meeting shall be presumed to have been done in good faith. Then it may be necessary to enact that mortgage deeds relating to specific parcels of land shall be deemed to apply to the land received in exchange on consolidation. Occupancy tenants, who lose their rights by abandonment or those who have no power to transfer their rights, may need protection, although it is hardly conceivable that any court would penalize a man for consolidation. Then there is the difficulty connected with absentees: in the central districts of the province it is not uncommon for the poor cultivators to seek their fortune in America or Australia, etc., without abandoning their rights in their ancestral plots. At present, the brother usually guarantees the consent of the absentee, but there are dangers in this. Tenants who claim compensation for disturbance may give trouble, but this should not be beyond adjustment. The time for compulsion has not yet come but the experience of other countries suggests without some such powersthe work will not proceed very far. Hitherto, the propaganda has been carried on amongst co-operators whose experience of the credit society has served to show the advantage of joint association and it will be better to let the successful examples speak for the merits of the scheme before any compulsion is contemplated.

The work is proceeding steadily, and it is hoped that about 100 to 150 more villages will be readjusted during the current year.—*The Agricultural Journal of India, Vol. XVII, part I.*

VIII.

Notes on Fencing.

Some few years ago, the United States Department of Agriculture published a Bulletin on the fencing of farms. This official report, which was published solely for distribution amongst American farmers, contains so much excellent matter on the subject, that we append a few extracts :—

"There are four main types of fence in use in this country — wire, wooden, hedge and stone — but there are almost numberless modifications of these types. Present day conditions, with high-priced land, scarcity of timber, and the consequent high cost of materials for wooden fences, as well as the higher wages paid to farm labour, have made it impracticable in most localities for the farmer to construct any but wire fence.

Hedge-rows make very poor fence ; they are also expensive. They occupy excessive ground space, form breeding places for weeds and insects, and require much labour to keep them in order.

Rail fences are blown down by the wind when they are placed in unprotected places, and they are sometimes pushed over by stock. They have to be rebuilt, on an average of once every 12 to 15 years. Each time they are rebuilt, some of the bad rails have to be discarded.

The picket fence is very expensive to keep in repair, as the pickets are very heavy, especially when wet, and cause the fence to sag.

Broad fences are excellent for some purposes, as the protection of a barn yard from heavy winds. As commonly built, they are comparatively short lived, and the cost of keeping them in repair is considerable. They are too expensive to be used for field fence.

Hedge does not make a good fence. If swine are to be fenced, wire must be added in order to make it effective. Hedge plants are often killed by one cause or another, and then there is a gap in the fence to be filled if it is to be stock proof. Even if the hedge is kept trimmed, it makes considerable land unfit for cultivation, and, if it is not kept trimmed the amount of land it wastes increases in proportion to the size of the hedge. The trimming is an expensive operation, and amounts to more than the cost of repair of wire fencing.

English farmers were forced to use the hedge fence as a means of inclosing their lands on account of the scarcity of timber in that country.

A stone wall when properly constructed makes a very satisfactory fence for all kinds of stock but sheep. They will climb over it unless a rail or wire is run over the top. Stone fences, if not well built with foundations of large stone, will be heaved by frost action. They also

form a breeding place for brush and weeds and harbour insects and burrowing animals. At the present time the labour cost of building a stone fence is so great that its construction is impracticable.

A farm fence should combine the two qualities of service and economy. To give satisfactory service it must be constructed so as to turn all kinds of stock, and that without injuring them. To be economical it must be built cheaply as is consistent with durability. The fence that is erected at a low initial cost is not necessarily economical, for it may be short-lived, which may make it expensive.

The cost of maintaining a farm fence is determined by five factors: interest, repairs, and depreciation on the fence itself, interest on the value of the land rendered unusable, and the expenses of keeping down weeds. The cost of repairs and the annual depreciation depend largely on the construction. If a fence is made from a cheap grade of material and is cheaply constructed, it will need frequent repair and will be short-lived. Such a fence will have both a high repair and high depreciation charge, which will in most cases more than counterbalance the increased investment cost that the erection of a more substantial fence would require. If a fence is made of good materials and is properly built, its repair and depreciation charges should be very low; but if the increased cost does not represent a corresponding increase in service, the investment charge will be so much greater that the decrease in repair any depreciation charges will not counterbalance it.

The efficiency of the fence depends upon the quality of the wire and posts used and upon the manner of construction. The first step in the construction of a fence is to select the kind best adapted to the purpose for which a fence is needed.

Barbed wire, when used to inclose extensive pastures and where only cattle are to be restrained, makes a satisfactory fence. Generally speaking, however, its use alone as a fencing material is not desirable. Woven wire fencing is fast replacing the other types in use on the general farm where several kinds of stock are to be pastured. Fifty-one per cent of the total fencing used in the area covered by this study is woven wire, and the percentage is rapidly increasing. This woven wire fencing is made up in many different styles as regards height, spacing of the wires, and size of wire.

The cost and life of the various styles of woven wire fencing differ greatly. Many purchasers consider the first cost of the various kinds to such an extent that they lose sight of the difference in their length of service, which is the controlling factor of their ultimate cost.

The first cost of the fence can be materially lessened by eliminating unnecessary material from the fence in the shape of wires that are not needed ; for example, when cattle, sheep or horses are to be fenced against, it is not necessary to have a fence with such close spacing as is required when swine are to be turned. The common general-purpose fence in use is one having approximately 10 line wires and a total height of approximately 4 feet ; the bottom wires are spaced about 3 inches apart. Such a fence is admirably suited to general purposes where both large and small stock are to be fenced in, but it is not essential to the farmer who keeps either cattle, horses or sheep, and no swine. A woven fence with fewer wires and wider spacing will serve to turn cattle, horses and sheep, and such a fence can be erected at considerably less expense, due to the fact that there are less material in it.

In the construction of a fence, the question of the selection of posts is a very important one. It is not advisable to construct a permanent wire fence on posts that will not last as long as the wire. When this is done the fence has to be restretched on a new set of posts, the cost of repairs will be considerably increased, and the full efficiency will not be gotten from the wire. The size of posts, the amount of seasoning they receive before being set in the ground, the quality of timber from which they are cut, the kind of soil, the climatic conditions to which they are subjected, and the kind of stock that are to be fenced against, all influence the life of the post.

To sum up the fence-post position, it would seem that the decrease in the supply of timber suitable for use as posts and the increase in cost of this timber to the farmer will, in the near future, make it advisable to use a substitute for wooden posts or to treat the cheaper woods with a preservative material that will serve to prolong their life.

It has been found that creosote, a by-product in the manufacture of coal-tar, is the cheapest and most effective preservative, and that naturally short-lived timber treated with it will withstand decay as long as the most durable woods.

The posts that are to be treated should be thoroughly seasoned and the bark should be removed from them so that the preservative will be able to penetrate into them.

The posts are first placed in a tank of creosote which has been heated to a temperature of about 222 degrees F. They are left in this tank until the creosote has penetrated through the sapwood of the post. When the post has been in the hot creosote the desired length of time it is then placed in a cold creosote bath, where it should be left for several hours.

While in the hot creosote the fibres of the wood expand and force out the air and moisture present. When placed in the cold creosote, they contract and form a partial vacuum, thus drawing a quantity of the preservative into the wood cells.

The equipment necessary for the first process is a single tank which is large enough in diameter to hold the number of posts it is desired to treat at a time, and it must be high enough to support the posts and to allow the creosote to stand about 6 inches above the mark that will represent the ground line on the post when set.

It is claimed for steel fence posts that they form a protection for stock in that they ground currents of electricity carried by the fence during electric storms. For this same reason they should prolong the life of the fence, as the disintegration of the wire is partially brought about through a electrolytic action. The unfavourable criticism of steel posts is that they bend by heavy stock rubbing against them. This may be avoided in two ways: First, if the fence is properly constructed, it should be tight enough that, when pressure is brought to bear on the fence, the strain will be transmitted to the end posts and the intermediate line posts, and thus not brought to bear on any one post alone; second, by the use of heavier posts.

In handling a well-seasoned concrete post, care must be used not to jar it more than is absolutely necessary. Owing to the excessive weight of concrete posts, it is very doubtful if fencing can be erected as quickly with them as with wooden posts. They must also be handled more carefully. They should be well set in the ground to prevent heaving. Should the post heave so as to lean over, its weight will tend to pull the fence down.

The manner in which the fence is erected has much to do with the service to be gotten out of it. No matter how good the wire and posts, if the fence is not properly constructed it will be a very poor one. The cost of erecting a fence is such small part of the first cost of it that this work should always be well done, yet it is no exaggeration to say that 50 per cent of the wire fences in use are not properly constructed. The ends and corners are by far the most important elements of the fence. It is absolutely essential that they remain firm and solid in order to hold the fence rigid. In building a fence, therefore, the first thing to consider is the placement of the corner.

End, corner and line posts should be placed so that the ground will have time to settle and harden around them before the fence is strung. It is more essential that the end and corner posts be placed some time

previous to the stringing of the wire. The best time of the year to set posts is in the spring after the frost is out and when the ground is soft. It will thoroughly settle soon after the frost leaves and will leave the posts solid. The wire then can be strung whenever there is time for this work. Whether the posts are set or driven they should be kept in a straight line with the ends of the fence. If there is a curve in the fence the posts may be set so as to make a slight angle, and the post at the apex of the angle should be thoroughly braced in both directions. When steel posts are used they may follow the line of the curve, but in such a case they should be set in concrete and be anchored against the direction of the pull on the fence by using a brace set in concrete, or by the use of a deadman. When the fence is being built over a hilly country or where there are depressions in the fence row, the posts that are placed in the depressions should be anchored down so that the upward pull of the fence will not tend to draw them out of the ground. This may be accomplished by spiking 2 by 4 cross pieces on the bottom of the wooden posts before setting them in ground. If steel posts are used they may be set in concrete. The distance apart line posts should be set depends on the location of the fence, and the number and kinds of stock to be turned.

In order to construct woven-wire fencing properly, certain tools are necessary These consist of a woven-wire stretcher, a single wire stretcher, to be used in attaching the fence to the end posts, a pair of wire cutters, a barbed wire stretcher, tool and hammers for stapling and fastening the fence. Some device should be used to unroll the barbed and woven-wire. This may be done by attaching the roll of the wire to the back of the wagon so that it will unreel as the wagon is drawn ahead, or it can be unreeled by running a bar through the core and drawing it along with a horse. Before the wire is stretched, the fence row should be free from obstruction, and ridges and uneven surface should be smoothed off, so the fence will be straight on the ground.

The stretching should be continued until the line wires are so taut that they cannot be pressed together by the two hands. If the ground is uneven, the fence should not be stretched so straight and tight that the wire cannot be drawn to its proper height on the posts. After the fence is stretched it should be securely fastened to the corner toward which it is being stretched. The next step is to fasten the wire on the line posts. In doing this the line wires should be kept as nearly horizontal as possible. They should be allowed to follow small irregularities in the ground line and thus zigzag up and down post to post. The fabric should not be fastened tightly to each post; the staples or ties should

permit horizontal movement of the wire. This will allow the weight of the fence to come directly on the corner posts, and will take care of the contraction and expansion of the wire caused by varying weather conditions; also if a blow is delivered against the fence, it will not be borne alone by the fabric and posts at the point struck, but the force of it will be distributed along the entire fence line. The barbed wire should be stretched and fastened after the fabric has been fastened in place. It should be placed about 4 inches above the top of the woven-wire so that stock will not be able to get their heads between it and the woven-wire. *A woven-wire fence is not complete without the strand of barbed-wire above it; this protects the woven-wire by preventing stock from reaching over and crowding it down.*

The cost of maintaining foreign fences consists of (1) the interest charged on the money invested, (2) the annual depreciation charges, (3) repairs, (4) interest on the value of the land which is covered by fence rows and from which the farmer derives comparatively little or in some cases no benefit, and (5) the expense of keeping down weeds.

The repair charge will vary with the kind of fence used. The two most important factors influencing them are the quality of the fence and the use to which it is subjected. If the fence is built from good materials and is well constructed, the annual repair bill will be greatly lessened. The fence placed around a stock yard or pasture field will be subjected to harder treatment than one around fields where stock seldom reach it. Also, certain kinds of stock and some individual animals are harder on a fence than others. The repair charges on a fence are light during the early life of the fence and increase as the fence grows older. There is, however, one item of expense which has to be considered as much with a new as an old fence. This is the cleaning up of the fence row and keeping it free from grass, weeds, and brush. It is estimated that the cost of keeping the fence rows free from weeds, etc., amounts to one per cent per rod per year.

It has been found by averaging a large number of estimates that when hedge is trimmed once a year, a man can trim thirty rods per day; when it is trimmed twice a year, a man can trim seventy rods a day; and when it is trimmed three times a year, a man can trim hundred and ten rods a day. The cost of keeping the various kinds of wooden fences in repair is very high.

When farm land is high priced, the amount of land that is covered by fence rows becomes a matter of importance.

The amount of land that the hedge fence renders useless for cultivation will depend upon the size of the hedge. If it is left untrimmed,

it will sap the fertility of the soil for more than a rod on each side of it ; if it is kept well trimmed, it occupies nearly double the amount of land taken by a wire fence. If the season is dry, the hedge does much more damage than when there is plenty of rainfall, as its root system extends out to a considerable distance and takes up moisture that is needed by the crops in the adjacent fields.

Stone, hedge, and the different types of wooden fences were desirable at the time they were first built, but changing economic conditions make them impracticable at the present time, and they are being replaced by wire fencing.

To get the maximum of service out of a fence, it is absolutely necessary that it should be well built. The corner posts must be placed solidly in the ground in such a manner that they cannot be heaved by frost or drawn loose by the pull of the fence. The fabric should be strung tightly to the end posts, but *it ought not to be tightly stapled to the line posts.* It should be fastened to the line posts in such a manner that the wires may move in a horizontal direction to take care of the contraction and expansion due to the changes in temperature and to distribute the force of a blow along the fence line so that the strain will not come entirely on any one or two posts or any one point of the wire. *A barbed wire should be placed a short distance above the top of the woven-wire to prevent cattle and horses from crowding it down when reaching over or rubbing against the fence.*

Cheaply constructed wire fences are expensive to keep in repair. Wooden and hedge fences require a large annual expenditure to keep them in shape.

Worm-rail and hedge fences occupy much more ground space than do the other types of fence in use in the area studied. Stone fences also occupy much ground, but very few of them were found in this area.—*The Tropical Agriculturist, Vol. LVIII, No.* 5.

Announcement.

A sale of bull calves from the Hebbal Dairy Herd will be held during the Annual Meeting of the Mysore Agricultural and Experimental Union in November of this year. These calves are all out of Hallikar cows with a milk yield considerably above the average and are of good type. They should develop into valuable breeding animals. All interested are cordially invited to attend this sale. The date and time of sale will be announced later.

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